

The Journal OF THE Royal United Service Institution.

VOL. XXI.

1877.

No. XCI.

LECTURE.

Friday, May 11th, 1877.

VICE-ADMIRAL the RIGHT HON. SIR JOHN C. DALRYMPLE HAY,
Bart., C.B., M.P., &c., &c., Vice-President, in the Chair.

THE THORNYCROFT TORPEDO-VESSELS; THEIR CONSTRUCTION, ARMAMENT, &c., AND THE RESULTS OF CERTAIN EXPERIMENTS THAT HAVE BEEN MADE WITH THEM.

By Mr. JOHN DONALDSON, Assoc. I.C.E., and Firm of Messrs. Thornycroft and Co.

SPEAKING generally, naval warfare heretofore has been conducted on the surface of the water, and a fighting ship has usually been constructed so as to carry her offensive and defensive equipment about and above her water-line, her guns and the bulk of her armour-plating being always above that line, and the remainder of her armour-plating only extending below it sufficiently far to protect the vessel from shot while rolling.

The thickness and strength of the bottom have been usually determined by structural considerations, and in modern ironclads it has been kept as light as possible in order to secure the buoyancy necessary for carrying the heavy guns, and the heavier plating of these huge vessels. The consequence is that the bottom of an ironclad is her most vulnerable part, and a vessel costing half a million of money, and carrying say 500 men, may be sent to the bottom at any moment by means of ramming or the successful explosion of a torpedo.

It may be urged that ramming is not always successful, and doubtless, the ram—being of necessity a heavy and ungainly vessel, not easily diverted from its path—may be eluded by skill and dexterity on the part of the Officers and crews of the intended victim.

From a well planned torpedo-attack however, in sufficient force, I believe there is no escape, and it is of vessels specially constructed for this purpose that I propose to address you this afternoon.

I think I am right in stating that the first attempt to use torpedo-boats systematically, was made during the American war, and as two

vessels at least—the United States' steamer “Housatonic” and the Confederate ram “Albemarle”—were actually sunk, and several others severely damaged by means of these weapons—besides the apprehension excited among all the vessels engaged—the attempt may be considered as having been decidedly successful.

The torpedo-boats used on these occasions were either submarine boats, specially designed and constructed for the purpose, or ordinary steam launches fitted with outrigger torpedoes. Neither of these types of boat is well suited for the work, as in the first case, independently of the difficulty of steering a boat under water, it would be almost certain to be destroyed when the torpedo exploded, and so sacrifice the crew engaged in the attack (as happened in the case of the sinking of the “Housatonic”), and in the second case the noise from the funnel, and the want of speed in ordinary steam launches, would effectually (except when the attack was made on a dark night) betray their position, and allow them to be made targets of, long before they came any way near their enemy.

Von Scheliha in reviewing the experience gained during the American war in the use of torpedo-boats, considers that submarine boats acting independently are quite unsuited for torpedo warfare, and that a swift jolly-boat, rowed with muffled oars, and provided with a self-acting contact torpedo, fastened to the socket of a movable torpedo spar 12 feet long, was preferable to any submarine boat. He further states that the general conclusions arrived at by American engineers were:—“That a torpedo-boat should have a speed of at least 11 knots, as the greater the speed, the less is the danger of being discovered, or struck by the enemy's missiles; that the engine must work without noise, and no smoke should be visible; that the boat must obey the rudder, and that the crew should be protected “against musketry, and the fire of light artillery.”

The majority of these requirements could be satisfied without much difficulty; but the problem as to speed remained—as far as small boats were concerned—unsolved till 1871, when Mr. Thornycroft brought out the far-famed “Miranda,” a vessel under 50 feet in length, which, when experimented on by Mr. Bramwell in the spring of 1872, attained the astonishing speed of 18·65 statute miles, or nearly $16\frac{1}{4}$ knots per hour.

These remarkable results did not remain long unnoticed by torpedists, as about this time the Whitehead torpedo was being introduced; and the question of how best to use torpedoes in offensive warfare was beginning to receive that attention which I have no doubt will be well justified in the next great naval war.

The first Government to recognise the great advance made by Mr. Thornycroft in the speed of small boats was the Norwegian, which, in 1873, gave my firm an order for our first torpedo-boat.

This boat, represented by diagram A, was 57 feet in length by 7 feet 6 inches beam, drew 3 feet of water, and the stipulated speed was 16 English statute miles, or nearly 14 knots per hour; which speed was not to be ascertained by a mere measured mile trial, but was to be 16 miles through the water in a run of one hour's duration.

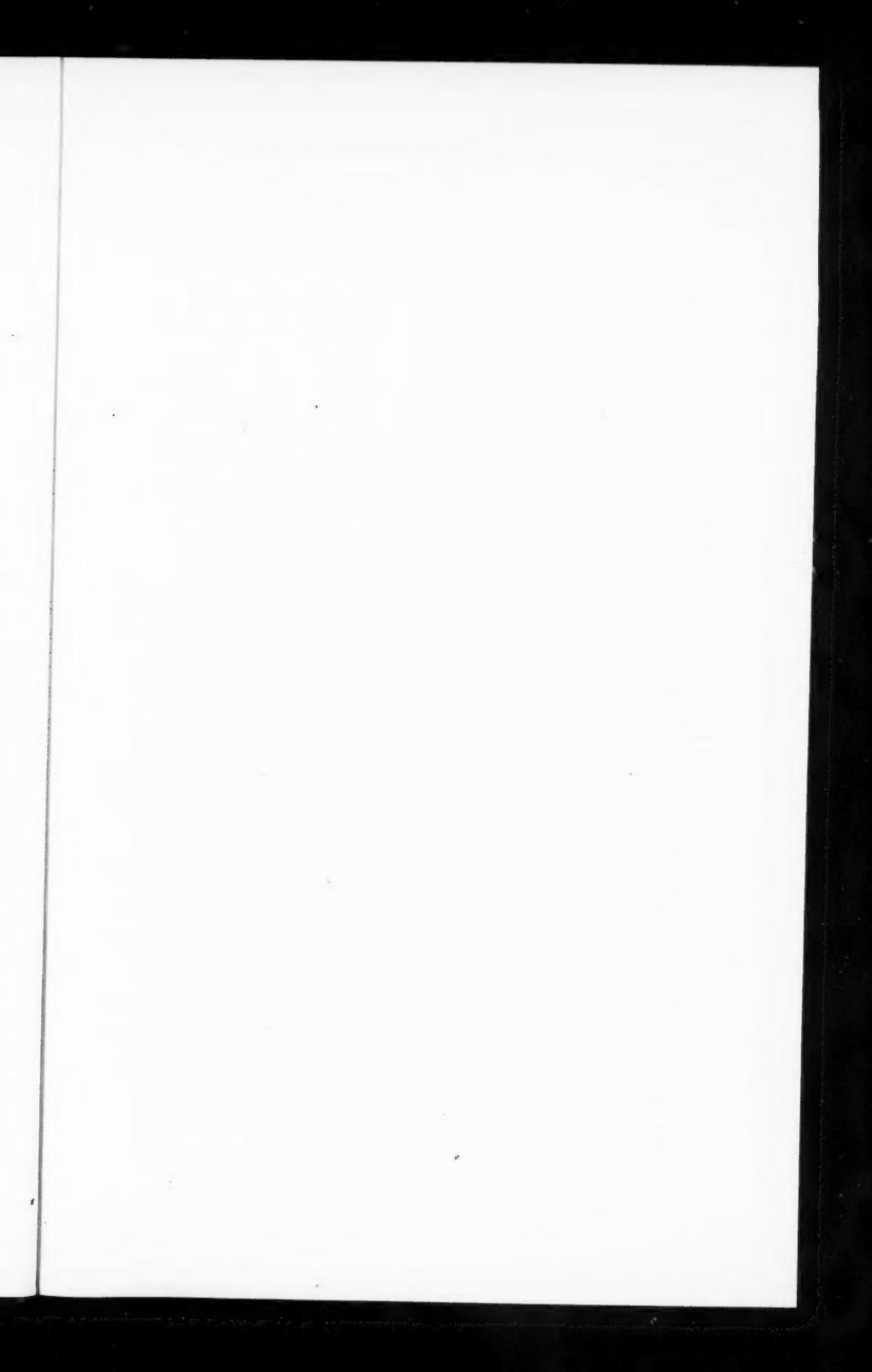


Diagram A.

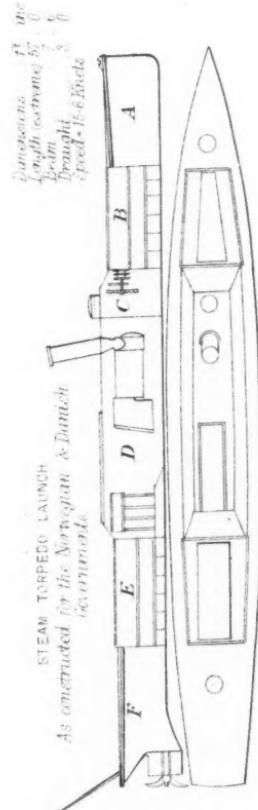
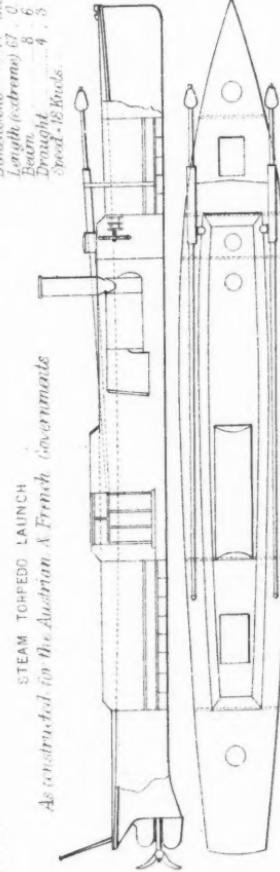


Diagram B.



The hull of the vessel was constructed entirely of steel plates and angle bars, and as may be seen from the diagram, was divided into 6 water-tight compartments, A, B, C, D, E, F.

The compartments marked A and F in the stem and stern were for stores; those marked B and E were fitted with seats for the crew, and were provided with movable steel covers, so that on going into action, or during rough weather, they might be completely covered.

The compartments C and D are for the steersman and the machinery respectively, and were covered completely by steel plating $\frac{3}{16}$ of an inch in thickness—a thickness which has been found sufficient to withstand Snider or Martini-Henry bullets, fired from a distance of 20 paces, as illustrated by the specimens on the table.

The compartment D was furnished with a hood, having slits $\frac{1}{4}$ of an inch wide, all round, through which the steersman could see with sufficient distinctness to direct his course easily. Motion was communicated from the wheel to the tiller by means of steel-wire ropes, which it was originally intended should be encased in wrought-iron tubes.

The possibility however of these tubes being bent by a shot, and so jamming the wire ropes, led to this arrangement being abandoned, and the ropes were simply run through eyes at intervals along the side.

The engines were compound, of the usual inverted double cylinder-direct-acting type, capable of developing about 90 indicated horse-power, and were fitted with a surface condenser, so that the vessel could run in salt water, without danger of injuring her boiler.

A small tank contained a supply of fresh water, to make good deficiencies arising through leakage, and from steam escaping at the safety valves, &c.

The circulating, air, and feed pumps were driven by a separate engine, as we feared at that time, that it would be impossible to run them at the same speed as the main engines.

The boiler was of the locomotive type, the shell being made of Bessemer steel; the fire box, and its stays, of copper, and the tubes, of solid drawn brass.

The armament was not supplied by us, but I have reason to believe that it consisted of a cylindro-conical shaped torpedo towed from the top of the funnel, round which a ring was fitted with two pulleys for the towing ropes: the strain being taken off by means of two stays attached forward.

The length of this torpedo was 13 feet, and the diameter 9 inches, and with a speed of 11 knots, it has diverged to about 40 degrees from the direction of the boat's motion when running in smooth water.

The torpedo is worked by means of a small winch and brake fixed on the after part of the engine-room skylight, davits are provided for dropping the torpedo overboard.

The method by which the contract speed of the boat was to be ascertained was prescribed to us by the Norwegian Government, and consisted of running the vessel at full speed for one hour, and counting the number of revolutions made by the propeller during

that time. The vessel was afterwards to be run six times over the measured mile, and the number of revolutions necessary to do a mile in still water ascertained.

The number of miles actually done in the hour was then to be found by dividing the number of revolutions done in the hour by the number required to do one mile.

The problem of finding the number of revolutions required to do a mile in still water, presents no great difficulty if the mile trials are run in still water, and consists simply of finding the arithmetical mean of the number of revolutions done on the six runs.

If, however, the trials are run in a river like the Thames, where there is a considerable current, it is evident that the vessel will be under the influence of the current for a shorter time when going with it, than when going against it, and the result would be that if the arithmetical mean were taken, a larger number of revolutions would apparently be required to do a mile, than were actually required.

The number of revolutions required to do a mile in still water, when the mile trials are run in water having a current of which the velocity is constant, or nearly so, is found by adding together the product of the number of revolutions made by the boat when running with the current, by the time taken to run against the current, and the product of the number of revolutions made by the boat when running against the current, by the time taken to run with the current, and dividing the sum by the sum of the times.¹

On the preliminary trials, we found we could do our contract speed of sixteen miles per hour without much difficulty, but we believed the boat was capable of doing more, and as the Norwegian Government in impressing on us the high value they attached to speed, had put us in a position to try experiments, by offering a premium on every mile, or part of a mile, by which the speed exceeded sixteen miles per hour,

¹ This is shown more clearly by the following investigation, in which I assume that the velocity of the current is constant during each pair of runs,—an assumption which is not quite correct for tidal currents, but, in the case of boats having high speeds like ours, is very nearly so:—Let x = number of revolutions per knot in still water, n = velocity of tide, R = revolutions with the tide, t = time with the tide, R_1 = revolutions against the tide, t_1 = time against the tide. Then distance run by boat with the tide in knots = $1 - nt$, and distance against tide in knots = $1 + nt$. Number of revolutions made under the circumstances respectively:—

$$R = x(1 - nt) \dots (1) \quad R_1 = x(1 + nt) \quad (2)$$

$$\frac{R}{R_1} = \frac{1 - nt}{1 + nt_1}, \text{ or } R + Rnt_1 = R_1 - R_1nt$$

$$n(Rt_1 + R_1t) = R_1 - R \therefore n = \frac{R_1 - R}{Rt_1 + R_1t}$$

$$\text{but from (1)} \dots x = \frac{R}{1 - nt}$$

$$\therefore x = \frac{R}{1 - t \left(\frac{R_1 - R}{Rt_1 + R_1t} \right)} = \frac{Rt_1 + R_1t}{t_1 + t}.$$

we reviewed carefully the whole design of the boat, with a view to find out what part was most susceptible of improvement.

The least efficient part seemed to us to be the propeller, so we cast about to find a propeller that would give us a little additional speed, but found none that we could depend on.

In the end, Mr. Thornycroft invented the propeller which now bears his name. This propeller, as may be seen from the specimen on the table, is a modification of the Dundonald propeller, the principal difference being, that in the Dundonald propeller the blades were inclined backward in straight lines, while in the Thornycroft propeller they are curved.

The object in both cases was to prevent the water from being driven out radially from the axis by the centrifugal force, and while the Earl of Dundonald tried to effect this by means of a straight blade, inclined backwards, Mr. Thornycroft considered that the blades should be curved, and that the curvature ought to vary in such a way, that the inclination of the blade to the axis should be greater near the boss than at the tip, on account of the greater amount of centrifugal force impressed on a particle of water near the boss as compared with a particle of water near the tip.

On the official trial, which took place on the Thames on the 17th October, 1873, the number of revolutions done in the hour was found to be 27,177, and the number required to do a mile in still water was

1,578. The distance run in the hour was, then, $\frac{27,177}{1,578} = 17.22$, or very nearly $17\frac{1}{4}$ miles.

The steam-pressure during the trial averaged 85 lbs. per square inch, and the vacuum $25\frac{1}{2}$ inches.

Boats of the same size, and similar in all particulars—excepting the engines which we improved by driving the air-pump, feed-pump, and circulating pumps off the main engines, and abolishing the auxiliary engine, which performed these duties in the case of the Norwegian boat—were made for the Swedish and Danish Governments. The result was an increase of speed to 17.27 miles, in the case of the Swedish boat, and to 18.06 miles, or $15\frac{5}{8}$ knots in the case of the Danish boat.

I have no information regarding the armament of the Swedish boat, but the Danish boat was armed with two spindle shaped torpedoes 12 feet long, and $11\frac{1}{2}$ inches diameter, somewhat like the Whitehead torpedo. They were placed on deck longitudinally near the funnel, so as to facilitate launching, and were arranged to be towed from an upright pole 8 feet high, placed about 6 feet from the stem.

A small winch was fixed on either side aft, to pay out the towing line, and to bring back the torpedo. By these arrangements the torpedo could be projected at a large angle from the direction of the boat's motion, and at considerable velocity. The speed of the boat when towing one of these torpedoes, is about 10 knots.

With regard to the strength of boats of this type, I may mention that when the Norwegian boat was fixed on board the steamer for conveyance to Norway, that vessel in going out of dock came

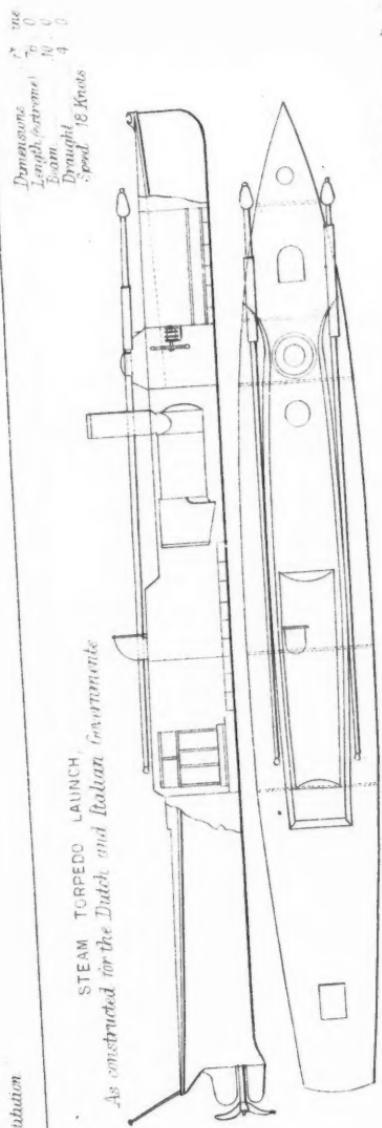
into collision with a telegraph-cable-laying steamer, the bow of which penetrated the side of the torpedo-vessel, and pulled her off the chocks on which she rested, causing her to fall a distance of from 15 to 18 inches, and bending her bottom slightly, but otherwise doing so little damage that she started immediately on her arrival at Stockholm on a voyage of 150 nautical miles to her destination in Norway. With regard to their sea-worthiness, I think I cannot do better than read the following extract from a letter addressed to me by Captain Koren, of the Norwegian navy, in which he describes this very voyage :—

“ In reply to your letter of the 14th, I have the pleasure to give you the following account of my trip in November last, from Götheburg to Horten (a distance of about 150 nautical miles) in the launch built by your honoured firm for our torpedo service.

“ The season being far advanced, I was anxious to take the boat to Norway as soon as possible, so having patched up the hole in her larboard quarter, and made a short trial trip, to see if the engine was in good working order, we started from Götheburg at two in the afternoon on the 21st of November.

“ It had been blowing stiffly the whole day from south-west, and my friends asked me not to start that day, as there would be a heavy sea rolling into the fiord, which I had to cross to get to the new canal and inshore passage to Marstrand, where I intended to stop for the night. Time pressed, however, and I started. I had engaged a Swedish pilot for the whole voyage on the testimony of his having traded on this coast for twenty-five years, and not doubting that he knew every creek and passage. When we got out in the above-mentioned fiord, it was blowing a stiff double-reefed-topsail breeze, with a corresponding but confused sea, but still we had some shelter from the outlying rocks. I ordered the pilot to steer for the opening of the canal on the other side, a route which would let us have the sea about four points on our port quarter; but that fellow coolly told me that ‘he never went that way; he only knew the circuitous outer route,’ which would take us out into the open sea to round the island on which Marstrand is built. I did not know what to do at the first; it was getting dark and the wind was freshening, and the boat certainly did not look like a sea-going craft; but we had come thus far, and I thought it best to push on. We had about fifteen minutes to run with the sea on the beam, and when we lost shelter from the rocks, her movements were quite extraordinary, alarmingly quick, and great. However, she shipped no water, and having observed her for some little time, I knew there was no danger, and it was with a sort of pleasure I heard that stupid fellow of a pilot ask, ‘ If I thought the boat would capsize ? ’ When we had rounded the last island, and began running before the wind, the boat went quite steady, and we got safely into the harbour. Two hours after we came in it was blowing a most violent gale. The next day we had to pass outside the rocks for a distance of 20 miles; the wind had gone down, but there was a heavy swell. We had a pressure in the boiler of about 50 lbs. only, and the only inconvenience we expe-

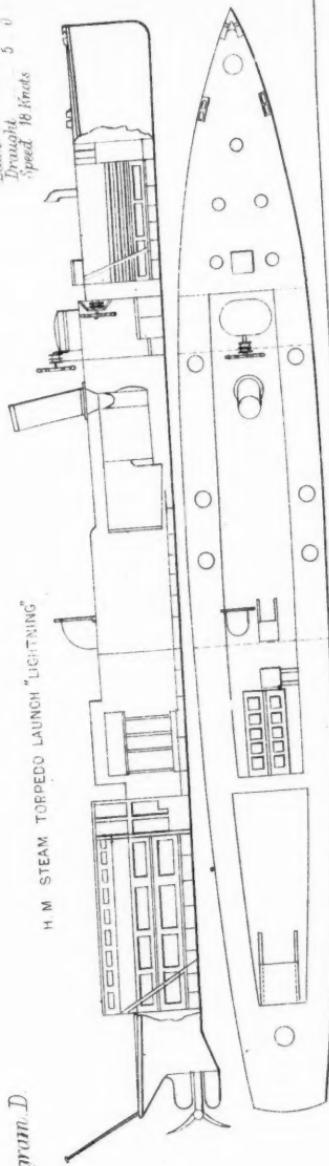
Diagram C
STEAM TORPEDO LAUNCH
As constructed for the Dutch and Italian Navies



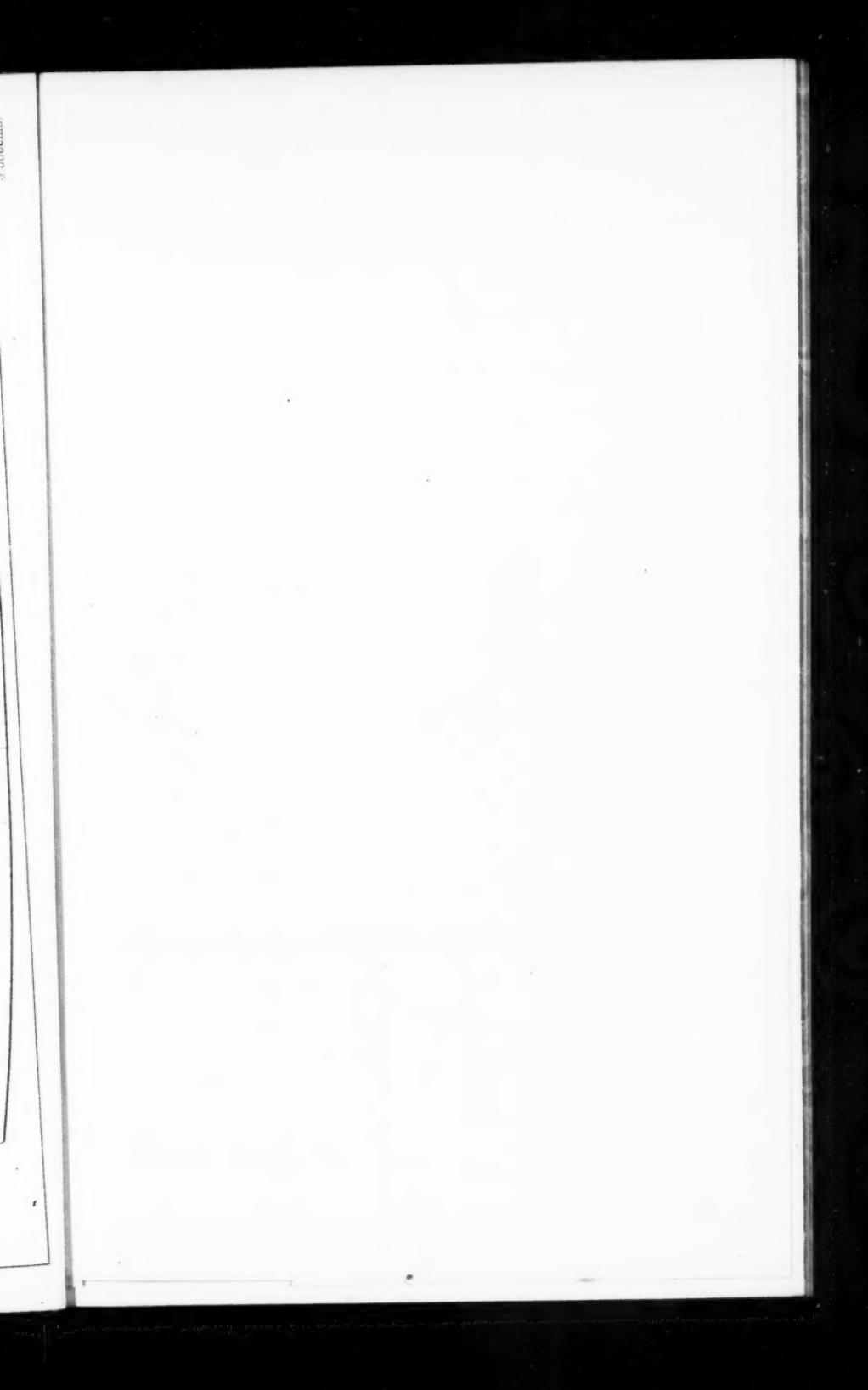
Dimensions
Length, extreme 70
Beam 14
Draught 4
Speed 18 Knots

Diagram D

H M STEAM TORPEDO LAUNCH "LIGHTNING"



Dimensions
Length (extreme) 84
Beam 10
Draught 5
Speed 18 Knots



TORPEDO LAUNCHES

Now under Construction for the French Government

Diagram E.

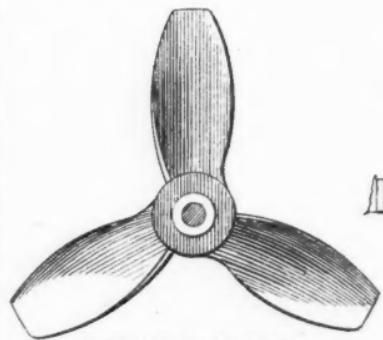
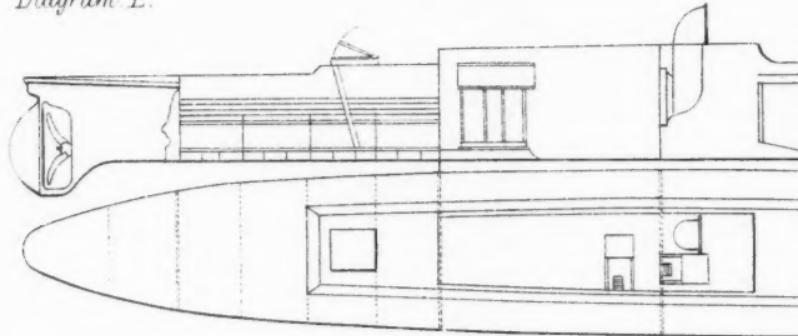


Diagram E.

CAPT. M^o EVOYS
Arrangement of Wires

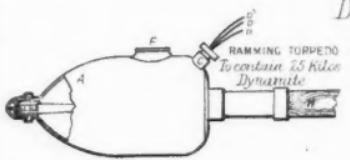
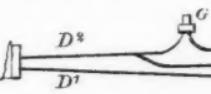
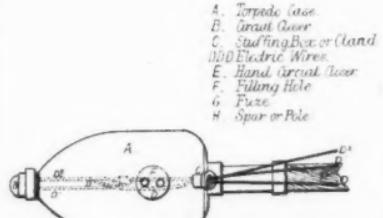
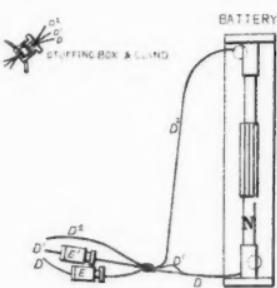


Diagram F.



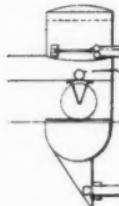
- A. Torpedo Case
- B. Head Case
- C. Stuffing Box or Cland
- D. Electric Wires.
- E. Hand Circuit Box
- F. Filling Hole
- G. Fuse
- H. Spar or Pole



SECTION OF F

Diagram G.

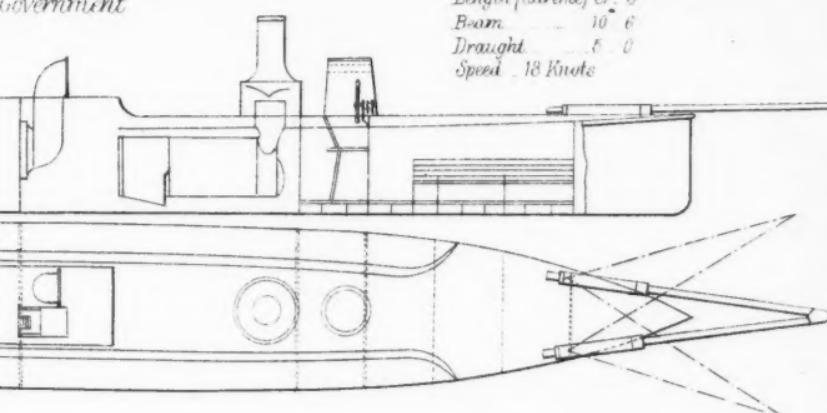
ARRANGEMENT OF TORPEDO



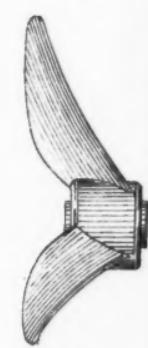
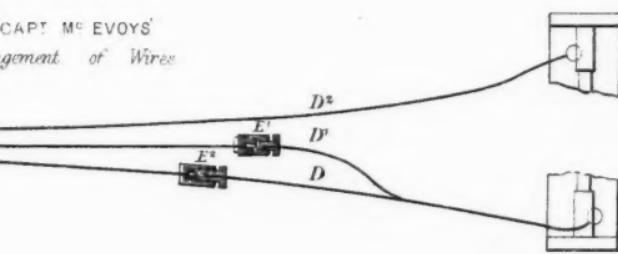
Centre of Vessel

Government

Dimensions 17 ins.
 Length (extreme) 87.0
 Beam 10.6
 Draught 5.0
 Speed 18 Knots

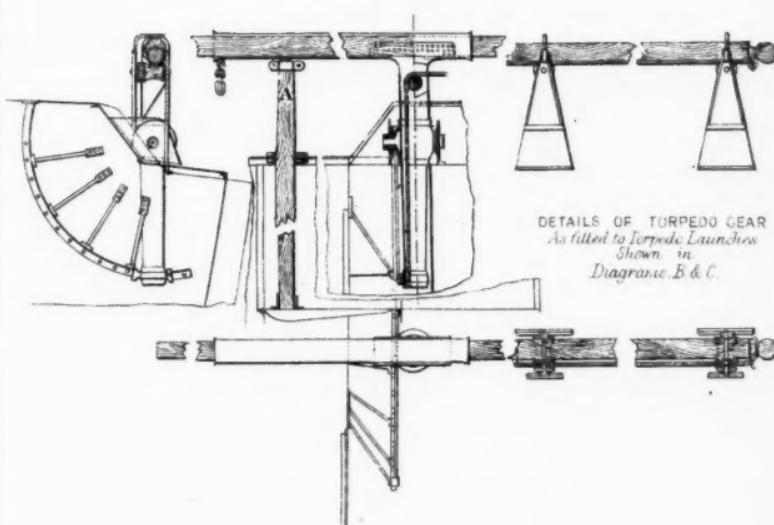


CAPT. MR. EVOYS'
 Diagram of Wires

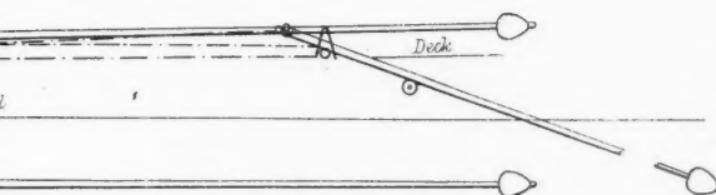


THORNYCROFT PROPELLER
 (SIDE VIEW)

Diagram H



OF TORPEDO GEAR





"rienced was the constant priming when the boat was rolling, and the "impossibility of using the injector, so we were obliged to keep the "donkey going all the time. We got to Horten in good time, and all "safe, and after my opinion, the boat is much more sea-worthy than "one could possibly think, judging from a hasty glance only."

In a subsequent letter, Captain Koren says:—"We ran on a flat "rock with your launch last year, and with tolerable good speed too. "In backing, the two-bladed screw knocked against the rock and got "a very curious new twist. The blades did not break, and the boat "came off without any sort of injury, as happily the rock was quite "smooth but the test was rather severe."

I am particular in giving these facts, as at the time this vessel was tried on the Thames, many persons hearing of the thickness of the plates employed in her construction, feared that she would not be sufficiently strong for sea work; and even Mr. E. J. Reed stated in the House of Commons that "he was always afraid of putting his foot "through the bottom, when he went on board any of our boats."

All the boats we have built are allowed to lie on the foreshore of the river opposite our works while they are being finished, and are left high and dry every tide, without taking the slightest harm, a want of care which I think would prove ruinous to any of our modern ironclads were they so treated.

Doubtless much of the misapprehension regarding the strength of these boats arises from people contemplating only a thin flat plate, which certainly does not appear to have much stiffness; but when that plate is of steel, and is hammered on an anvil to the shape of the boat's side, the case is widely different, the steel is to a certain extent tempered in the same way that a saw is, and the combination of the curved plates, and the strong framing which supports it, forms a structure which is well adapted to resist any ordinary detrusive forces which may be applied to it.

The next size of torpedo vessel is that supplied to the Austrian and French Governments, and is illustrated by diagram B. The dimensions are:—length, 67 feet; beam, 8 feet 6 inches; draught of water, 4 feet 3 inches. The guaranteed speed in the case of the Austrian boat was 15 knots in a run of one hour's duration, and in the case of the French boats 18 knots, in a run of two hours' duration. These boats were built of somewhat thicker plating than the 57 feet type, and the armour was extended, as shown by the blue shading on the diagram, down to the water-line on each side.

They were divided into six water-tight compartments, and they differed from the Scandinavian boats in having the spaces forward and aft of the machinery, permanently decked, instead of being covered with movable steel covers only.

The machinery was somewhat similar to that in the Scandinavian boats, excepting that the engines were capable of developing 200 indicated horse-power, and that the air was supplied to the furnace by being forced into an air-tight stoke-hole, instead of being forced directly under the fire-grate.

The armament of these vessels consisted of two torpedoes attached

to the end of wooden poles, $4\frac{1}{2}$ inches diameter and about 43 feet long, connected to the battery by insulated wires, and arranged to be fired either by coming in contact with the enemy's vessel or at any distance from it, at the will of the operator.

The torpedoes themselves were simply copper cases, like those on the table, and as illustrated by diagram G, of sufficient size, in the case of the Austrian boat, to contain 11,000 cubic centimetres of explosive, and in the case of the French boats, to contain 25 kilograms, or dynamite. At one end is the socket for the pole, and at the other, the contact arrangement, which consists of a metallic plate capable of being pressed against the ends of the studs to which the wires are attached. This plate and its connections are covered by an india-rubber cap, so as to render the cases water-tight.

In the middle of the case is the aperture for charging the torpedo. This is a hole $3\frac{1}{2}$ inches in diameter, into which, when the torpedo is filled, is screwed the cap F. The wires are introduced by the aperture C, fitted with a screw gland, so as to prevent the ingress of water.

The battery is a modification of Smees's well-known single acid battery and consists of six cells, fitted with platinized silver and zinc plates, which, in order to prevent unnecessary oxidation may be lifted and kept clear of the acid by means of the roller N.

The fuse (several specimens of which are on the table) consists of two strong copper wires, kept apart by means of a non-conducting composition, and connected by a very fine platinum wire, imbedded in fulminate of mercury, which is protected by a tinfoil casing. These fuses are used with a detonator—a long copper cap half filled with fulminate of mercury. The connecting wires are arranged in the neat and effective way patented by Captain McEvoy, of the London Ordnance Works, by means of which, with only three wires, the torpedo may be made to explode either on contact with the enemy's vessel or by means of a firing key, at the will of the operator. This arrangement is shown in diagram F. D and D_2 are the wires leading from the poles of the battery to the torpedo. The fuse is inserted in the wire D_2 at a point within the torpedo case, so that, when the case is charged, the fuse is entirely surrounded by the explosive. The connecting wire D_1 is attached to the wire D near the battery, and to the wire D_2 at a point between the fuse and the stud, to which that wire is attached in the torpedo case. A firing key is inserted in the wire D_1 at E₁, and a contact breaker in the wire D at E₂.

The firing key is simply an apparatus for connecting the two ends of the wire quickly. It is shown in diagram F, and consists of two pieces of vulcanite, through each of which the wire is led and fastened over the end. These pieces are kept together by means of a vulcanite nut, and a spring keeps the ends of the wire apart until pressure is applied.

The contact breaker is similar to the firing key, but there is no spring in it, and the two parts may be screwed backwards and forwards, so as to separate or connect the wires when required.

The object of having the contact breaker in the circuit is to prevent the torpedo from being exploded by contact with the enemy's vessel,

and so, to place the control of the explosive entirely in the hands of the operator. If it is in use, it will be seen that no current can pass through the wire D, and that it is only possible to fire the torpedo by pressing the firing key and sending a current through the wires D₁ D₂. Should it be desired to fire by contact, the contact breaker is screwed up, so that the wire D may be put in circuit; a current is then possible through the wires, and D and D₂ as soon as the circuit is completed by the contact plate being pressed against the studs.

However effected, whether by the firing key, or by contact with the enemy's vessel, as soon as a strong current passes through the fuse, the small platinum wire is heated to redness, and the fulminate of mercury exploded; this explodes the detonator, and with it the charge of the torpedo, the force of the explosion finding its way along the nearest path to the air, which path, if the torpedo is sufficiently close, is through the enemy's ship.

The arrangement for working the torpedo-poles is shewn on diagram H, and consists of two tubes riveted together at right angles so as to form something like the letter T. The torpedo-pole is put through the horizontal tube, which is free to move round the centre of the vertical tube, and the vertical tube is free to move through a quarter circle at right angles to the centre line of the vessel.

In attacking in front, the vertical tube is laid over, till it is parallel to the water surface, and the horizontal tube is allowed to incline sufficiently far to allow of the end of the pole, when run out, to be depressed from 8 to 10 feet below the water-line. It is held in this position by a pair of blocks attached to the top of the short mast A.

In attacking on the broad-side, the vertical tube is laid over till it assumes a position such as to allow of the pole when swung round, to touch an enemy's vessel at about 8 or 10 feet below the water-line.

The speed trials of the Austrian boat took place on the 11th September, 1875, when she did 24,700 revolutions on her hour's run on the Thames, and the number of revolutions required to do a knot in still water was found to be 1,357. This gives the distance run in the hour as 18·202 knots, or 3·202 knots over our contract speed. The steam pressure averaged 105 lbs. per square inch, and the vacuum 25½ inches during the run.

In the case of the French boats, the total number of revolutions done in the two hours' run in the roadstead off Cherbourg, was 49,818, and the number required to do a knot in still water was found to be 1,382, so that the distance run in the two hours, was 36·05 knots, or just over our contract speed. During the two hours, the average steam pressure was 108 lbs. per square inch, and the vacuum 25 inches.

The Austrian boat was sent to her destination on board a steamer, but the French boats, under the command of an experienced captain, steamed by themselves from Chiswick to Cherbourg, not crossing at the nearest points, and running along the shore, but going boldly from Dover, direct to Cherbourg.

Shortly after the arrival of the French boats in Cherbourg, they were altered so as to attack in front only, as the French authorities

found that these small vessels were better adapted for resisting the effects of an explosion at the bow, than at any other part.

The arrangement adopted is shown in diagram J, and consisted of a steel pole about 40 feet in length, having one end about 6 inches diameter, and solid, and the other about $1\frac{1}{2}$ inches diameter, and hollow; this pole was mounted at its solid end on small pulleys which ran upon two ropes stretched fore and aft of the vessel; the other end, to which the torpedo was attached, was led over a pulley fixed on the bow. Ropes passing over pulleys to a windlass in the after compartment were attached to the inboard end, and by turning the windlass, the pole was drawn backwards or forwards as required.

It will be observed that as the pole is drawn forward, the inboard end being constrained to move in a line parallel to the deck, the outer end is depressed in the water, and is so adjusted that when the pole is run out to its full extremity, the torpedo is depressed to about $8\frac{1}{2}$ feet below the water level.

The arrangements for firing were, I believe, similar to those described as having been fitted to the boats by us, but of this I have no definite information.

In February and March of this year some very remarkable experiments were made at Cherbourg with these boats, which not only shewed the terrible effect of an explosion on the vessel operated upon, but also the small effect that the explosion has on the torpedo-boat. The last of these experiments was made in the roadstead off Cherbourg on the 3rd March, in presence of Vice-Amiral Cloué, Contre-Amiral Jaurez, Contre-Amiral Lafont and many other officers of the French Navy. The vessel attacked was the "Bayonnaise," an old wooden frigate of about 2,000 tons displacement, which had been damaged in one of the earlier experiments, and was on this occasion kept afloat by means of empty casks. In order to realise as nearly as possible the actual conditions of warfare, the "Bayonnaise" was towed by the paddle-steamer "Coligny," at the rate of about 6 knots per hour. The attacking boat, under the command of M. Lemoine, came up at a speed of about 14 knots, which on nearing the "Bayonnaise," was reduced so as to prevent a collision between the two vessels at the moment of attack.

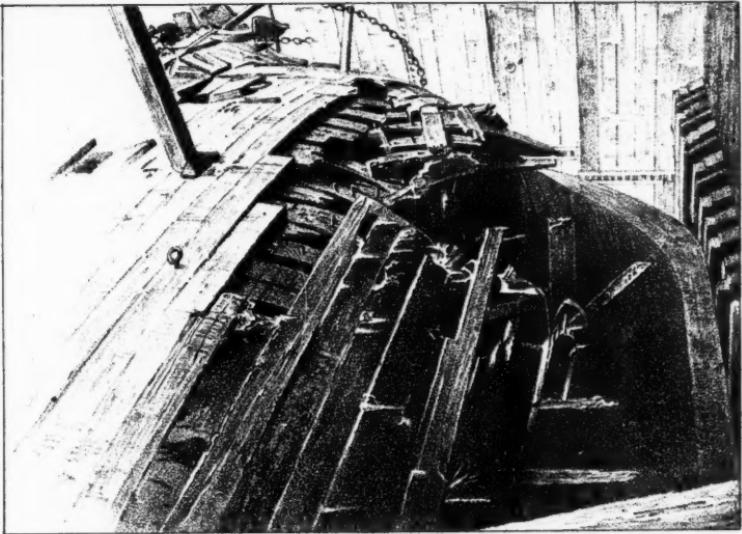
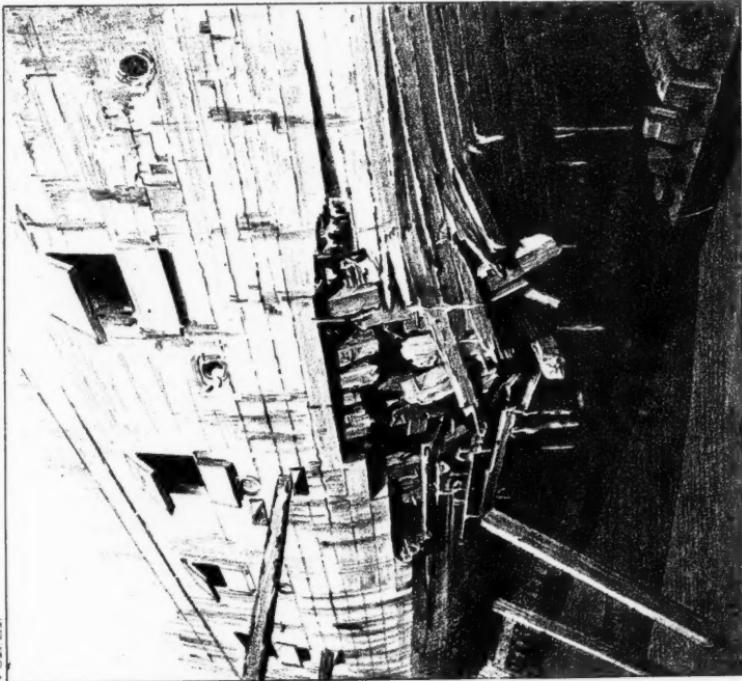
The torpedo charged with 15 kilogrammes of damp gun-cotton, submerged to a depth of $2\frac{1}{2}$ metres, or about $8\frac{1}{2}$ feet below the surface of the water, exploded immediately on striking, and the "Bayonnaise," with the hole in her bow, shown in the photograph on the table—large enough, I believe, to admit a full-sized omnibus—would at once have gone to the bottom, had it not been for the empty casks, with which she was filled.

At the moment of explosion, a slight shock was felt, and immediately afterwards a large wave was upheaved between the "Bayonnaise," and the torpedo-boat, which was driven backward a considerable distance, and completely covered with water, so much so that M. Lemoine and his brave companions for the moment could not say whether they had gone to the bottom or not.

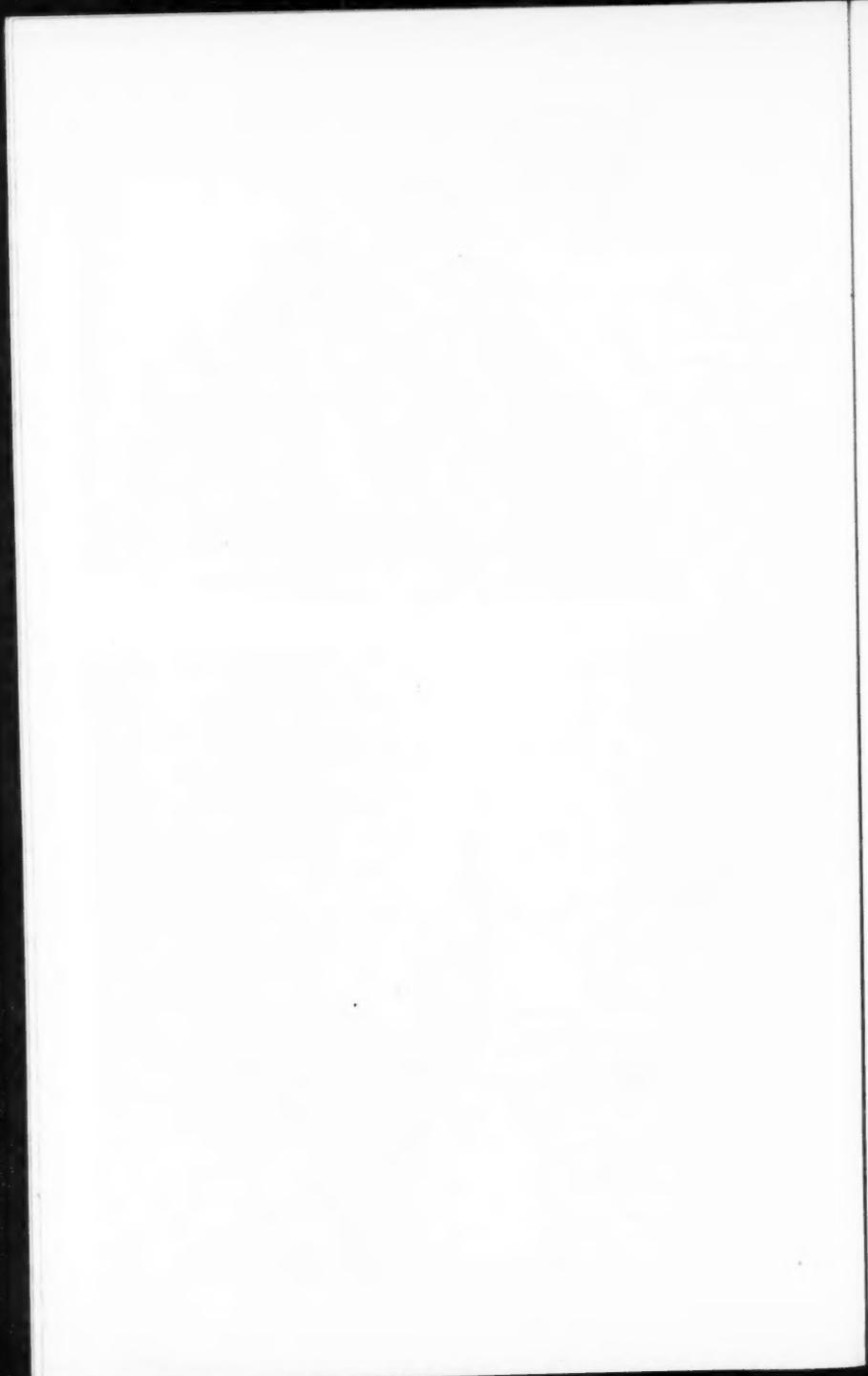
VIEW OF FRENCH VESSEL "BAYONNAISE"
Showing Breach produced by the Explosion of 15 Kilogrammes of damp Gun-cotton

VIEW OF FRENCH VESSEL "BAYONNAISE"
Showing Breach produced by the Explosion of 15 Kilogrammes of damp Gun-cotton.

Pl. IX.



J. J. Stevens



This state of doubt was soon dispelled however, and M. Lemoine steamed slowly off to report himself on board the "Coligny."

The effect on the torpedo-boat in attacking a wooden vessel like the "Bayonnaise," half filled with water, with thick wooden planking, and still thicker ribs, is, I believe, greater than it would be in attacking an ironclad, with its bottom of thin iron or steel, and the result showed very clearly that no harm is likely to happen to boats of this class, either in the hulls, or the machinery from the explosion of this formidable weapon.

I may remark that the second Thornycroft boat was not stopped in time, and ran into the "Bayonnaise," at a speed of about 8 knots, the result being that the bow was doubled up, but so little real harm done, that on the following day she steamed out into the roadstead in rough weather, and returned without shipping more water than could be easily disposed of by her bilge pumps. None of the machinery was displaced, and no joints broken.

One important result of the experiments made by the French Government, was the finding that only 90 per cent. of the weight of explosive that might be safely fired at the bow could be fired at the stern, and only 35 per cent. on the side.

The third size of boat built by us is that we are now supplying to the Dutch and Italian Governments; these vessels are 76 feet long by 10 feet beam, and are guaranteed to do a speed of 18 knots.

They are similar in design to the French boats, and differ from them in having engines of 250 indicated horse-power, and in having more freeboard forward, so as to make them better sea-boats.

The Dutch type will be armed with the outrigger torpedo, as supplied to the French Government, and the Italian type with the Whitehead or fish torpedo.

The exact details of the construction of this torpedo are kept carefully concealed from manufacturers, but generally it consists of a cigar-shaped vessel, varying from 14 to 19 feet in length, and from 14 to 16 inches in diameter. It is made of specially prepared steel, and is divided into three parts; the head containing the gun-cotton, and the exploding apparatus; the central part containing the machinery; and the third, or tail part, containing the supply of compressed air for the engines. The motive power is supplied by a small engine of the Brotherhood 3 cylinder type,—a type which lends itself readily for packing in a cylindrical chamber, and so compact, that I believe I am right in stating that an engine capable of developing 40 indicated horse-power can be made to weigh only 35 lbs. weight. The working pressure of air in the tail is usually about 1,000 lbs. per square inch, and the quantity carried is sufficient to propel the largest sized torpedoes a distance of 220 yards, at a speed of 24 knots, or 1,000 yards, at a reduced speed of 16 knots. By an arrangement connected with horizontal rudders, the torpedo can be made to run below the surface of the water at any required depth, and to keep at that depth till the end of its run. Such is the skill already acquired in the use of this torpedo, that I understand it would be almost im-

possible to miss an ironclad at a distance of 1,000 yards, even when the ship from which it is fired is moving at the rate of from 10 to 12 knots per hour.

We now come to the "Lightning" type of vessel, which is illustrated by diagram D, and the photographs on the table. This vessel is 84 feet long over-all, by 10 feet 10 inches beam, draws about 5 feet of water, and is guaranteed to do a speed of 18 knots on her trial. The machinery on board the "Lightning" is similar in design to that already described, and is capable of indicating 350 horse-power. The hull of the "Lightning" is made of heavier plating than we usually employ, and her lines are fuller, as she is intended for use in a tolerably rough sea if necessary; and in order that she may be able to remain at sea for some time, cabin accommodation on a scale larger than in any of the other boats is provided for the Officers and crew. The steering gear is arranged so that the vessel may be steered from the deck, or from the conning-tower, and the usual telegraph gear is fitted to communicate from the deck, or from the conning-tower, to the engine-room.

The top of the conning-tower is supported on three screws, so arranged that it may be raised or lowered, and the space for sight adjusted according to the range of vision required, or the risk to be run from the enemy's missiles.

The "Lightning" is to be armed with the Whitehead torpedo, which will be discharged from her forward deck by means of a discharging apparatus, the details of which I am not sufficiently familiar with to be able to give a description.

The torpedoes will be charged with air, by means of one of Mr. Brotherhood's air-compressing pumps.

The "Lightning" has not yet been officially tried, but on her preliminary runs in the Thames, she attained a speed on the measured mile of 19·4 knots per hour, a speed which will be somewhat reduced when she has her torpedoes and their gear on board, but which will leave us an ample margin on our guaranteed speed of 18 knots per hour.

The next size of boat is the 87 feet type, as illustrated in diagram E, of which type we have six in hand at present for the French Government.

These vessels are 10 feet 6 inches beam, and are built of heavier plating than the "Lightning," and we have undertaken that they shall maintain a speed of 18 knots in a run of three hours' duration.

The propellers, contrary to our usual practice, will be placed in front of the rudders, so as to give increased readiness in steering.

In order to prevent oxidation of the hulls as far as possible, we have arranged to galvanise the plates and frames below the water-line; and a spark-catching apparatus will be fitted to the base of the chimney, so as to prevent the position of the vessel being betrayed to the enemy during the night.

The armament of these vessels will be fitted by the French Government, and will, I believe, consist of an outrigger arrangement similar

to that now in the boats we formerly supplied to them. They are equally well adapted, however, for the Whitehead torpedo, and they may be fitted with the apparatus for discharging that weapon. They will also be provided with an apparatus for deadening the shock, in the event of their coming in contact with an enemy's vessel at too high a rate of speed, as happened to one of our boats during the experiments at Cherbourg.

I have now described the principal features of those boats we have built for torpedo service, and although the results in the matter of speed are high, they are not so high as we have obtained in some of our other boats,—as for instance, in that built by us last year for the Baroness Rothschild, and tried on the Lake of Geneva. This vessel, 90 feet long by 13 feet beam, maintained a speed of nearly 21 knots in a run, the whole length of the lake from Geneva to Villeneuve.

I may further add, that although this is the fastest boat in a long run we have built as yet, we have designed, and are prepared to build boats capable of maintaining a speed of 25 knots.

These vessels would be larger and more expensive than any I have described, but would, I think, be invaluable in war, either for actual torpedo work or for use as dispatch vessels.

High speed, although so thoroughly appreciated by foreign torpedoists, has not hitherto received that attention which it merits from our own people. I have reason, however, to believe that this will be remedied as soon as the official trials of the "Lightning" are concluded, but in the meantime—it may be on the eve of a great war—the fact remains, that we have only one fast steam torpedo launch in Her Majesty's navy, while other nations are providing them by the dozen, for the defence of their principal ports.

In advocating the value of high speed, I have sometimes been told that although very useful in its way, it is not required for torpedo work, and that an ordinary ship's launch, if directed to move slowly and silently against an enemy's ship, would be quite as efficient as a fast vessel; and as these launches are always required on board ship for other purposes, and are besides much cheaper in first cost, it is better to buy a large number of them than to have a few fast vessels for a special purpose. Doubtless this would be true, if the enemy's vessel were at anchor, and if an inefficient watch were kept on board; but this is a conjunction which I apprehend would be very rare in modern warfare.

I think it may be very safely asserted that numbers are only useful in war when their force can be brought to bear on the enemy; and I am quite certain that any number of ordinary 8 knot steam launches, fitted with outrigger torpedoes, might just as well be away on the China station as any way in the neighbourhood of an enemy's ironclad, capable of doing 12 knots, for all the harm they would do her.

All the ironclad would have to do would be to keep running at a little slower speed than her Lilliputian foes, and sink them in detail as they came within range.

On the other hand, take the case of the same ironclad appearing off one of our ports defended by a fleet of 18 knot torpedo-boats.

Nothing would require to be done till she came in sufficiently close to use her guns—say three miles at the outside—when, if half-a-dozen or a dozen 18 knot torpedo-vessels were launched against her, they would be alongside in half an hour from the time of their starting, even if the ironclad got away at once, and used her utmost speed in escaping.

If the torpedo-vessels were armed with the Whitehead torpedo, it would not be necessary for them to go close alongside, and so they would be less easily hit; but the danger of hitting objects running at even the slow speed of six knots per hour, or ten feet per second, relatively to the ironclad is very slight indeed.

Last year at Wimbledon there were 5,000 shots fired at the running-deer—a target moving at the rate of six feet per second, and out of these shots, fired from a fixed platform, by men who almost make a business of shooting—only one in ten hit the bull's-eye at 110 yards; while if the target was stationary, nine shots out of ten could always be depended upon as being bull's-eyes. Add to all these difficulties, men comparatively unaccustomed to shooting, firing at an uncertain distance from a moving platform, at a target moving twice as fast as the running-deer, when the torpedo boat is in chase of an ironclad, or five times as fast if the ironclad is caught napping, and some idea may be formed of the difficulty of hitting these boats.

Then if they were hit, no small-arm bullet would penetrate any part of them at even comparatively close ranges, on account of the obliquity of the surfaces exposed, while it is calculated that large guns firing Shrapnel, if the aiming were accurate, and the distance correctly ascertained, could only send $1\frac{1}{2}$ bullets for each round into the area exposed by a vessel as large as the "Lightning" at 1,000 yards.

In considering the question of the safety of the attacking boats, I do not think that sufficient value is given to the demoralizing effect of the stealthy approach of a vessel carrying so tremendous a weapon as a torpedo.

The French officers on board the "Coligny" during the experiments at Cherbourg said they experienced a decidedly uneasy feeling when they saw the two small grey-coloured boats gliding silently up, a feeling somewhat akin to that experienced on the approach of a deadly snake.

The most valuable experience however was acquired during the American War, and Lieutenant Cushing thus describes the dangers he ran from bullets while sinking the Confederate ram "Albemarle," and the small effect they had on him and his party:—

"The rebels sprung their rattles, rang the bell, and commenced firing, at the same time repeating their hail, and seemed much confused."

And again:—

"Three bullets struck my clothing, and the air seemed full of them."

The result of all this firing was—"the most of our party were captured, some drowned, and only one escaped besides myself, and he in a different direction." But he makes no mention of any having been shot.

The question is often asked, what is the best kind of torpedo for these boats? and it is a difficult question to answer. For the 57 feet sizes, such as supplied to the Scandinavian Governments, and the 67 feet boats, such as supplied to the French Government, I should say that either the outrigger, or a modification of the Harvey torpedo, is the best, as these boats could not carry the Whitehead torpedo, with its launching and air-compressing gear.

The Harvey torpedo might be used for the larger class of vessels, but I think the outrigger and the Whitehead torpedo are the preferable weapons.

The Whitehead is generally considered the safest torpedo to use, but if the men have to expose themselves on deck, even at 500 yards distance from their enemy while discharging it, I almost fancy it would be better to have them all under cover, and run the extra risk from the larger missiles, and to go close alongside, with the outrigger torpedo. The operation would, I think, be more certain in its result.

As an illustration of what may be done safely in going alongside and attacking large vessels, I may instance the daring attempt to sink the United States' steamer "Minnesota," by Captain Hunter Davidson, of the Confederate Navy. This officer proceeded from Richmond to Hampton Roads, in a small steam launch, armed with a torpedo containing 60 lbs. of gunpowder. Leaving Richmond in the evening, he travelled all night, and during the day hid himself and his vessel in a creek. He arrived in Hampton Roads the next night, and in going alongside the "Minnesota" he was hailed, and ultimately fired at; but such was the confusion, that he not only succeeded in exploding his torpedo, but in escaping safely back to Richmond, although firing and signalling were going on in all directions, and his engineer could not get his engine (a single cylinder one, which would hang on the dead centre) to start for some considerable time after the explosion of the torpedo.

I believe the best defence against attack from these torpedo-boats is to have other and similar boats steaming round the vessel to be protected, ready to ram or otherwise destroy the attacking boats.

Possibly some modification of the hand grenade might be used for this purpose.

Such guard-boats should have as much speed as the attacking boats, and arrangements should be made for hoisting them on deck, when they are not required for guard duties. We have designed some small-sized boats for this purpose, but I think the 57 feet type is quite small enough for sea work, and her weight of 7 tons is not a difficult problem to grapple in the way of hoisting.

The principal danger run by our boats is, undoubtedly, that of being sunk, and I have thought, for some time past, that it would be better to abolish the thick bullet-proof plating in their construction—excepting that immediately over the engine-room—and to use ordinary plating instead. The weight saved could then be used in the bottom, in the form of half bulkheads, sufficiently high to reach above the water-line at every third or fourth frame along the bottom; these half bulkheads are shown in red, for the sake of illustration, on the

hull of the French boat in diagram E. If a shot penetrates the boat, it does not follow that any of the crew will be struck by that particular shot; but it does follow that if the shot goes through the bottom, water will enter, and, unless the quantity is limited, the boat will sink. The half bulkhead protection limits the quantity of water that will enter, and, I should say, there would be no difficulty whatever in plugging up the hole made, and afterwards pumping the water out by means of the bilge-pumps.

Deb'tless, some of my audience may see some other ways in which these boats may be improved, and I shall feel grateful for any suggestions in this way.

The adoption of these suggestions, however, would depend on the responsible officers of the Governments ordering the boats; but I may say that, so far as my partner and myself are concerned, we are always willing to adopt any improvements, and we never knowingly allow any bad design, bad materials, or bad workmanship to pass from our works.

In conclusion, I beg to tender my thanks to the Council of this Institution for the opportunity they have afforded me of describing our boats, and to you, Gentlemen, for the patience with which you have listened to what I have had to say.

Mr. LEWIS OLICK, C.E. : In August, 1857, I was honoured by being appointed by the Danish Government to inspect one of the steam launches made by Messrs. Thornycroft for that Government. I cannot, therefore, be considered as an impartial observer, for, on the contrary, it was my duty to be very partial in favour of the Government that employed me. It may, therefore, be interesting to hear a report that is based upon facts which it was my duty to ascertain and to look into in the most careful manner. Having been brought up among such machinery as is made by Messrs. Maudslay, Sons, and Field, I have been used to first-class machinery, and am therefore not easy to satisfy. The boat built for the Danish Government had compound engines, with an intermediate receiver. The contract number of miles she had to make was 17 per hour; instead of which she made upwards of 18 miles on a careful trial trip. The indicated horse-power ought to have been 90, but I believe it was over 100; so that the boat in every respect came far above the contract figures stipulated. The boiler was of the locomotive type, worked by a centrifugal fan; and at full speed (18 miles an hour) there was no noise whatever perceptible, and there were no sparks coming out from the fire, so that she would not be seen by the enemy she was attacking. To enable us to take indicator diagrams, it was necessary to use a scale of 100 pounds pressure to the inch. Ordinary indicators could not have been used, and to take indicator diagrams at 500 revolutions per minute is somewhat novel; but, however, it was accomplished without the slightest trouble. There was also a feature in the machinery, at that time novel to most engineers; that was—to drive an air-pump at 500 revolutions per minute. I omitted to state that in calculating the indicator diagrams, which were no larger than could fairly be put inside the palm of my hand, I was obliged to use the ingenious instrument known as Amstler's planimeter. The revolutions on the measured half-mile were 514 per minute, and the true mean speed 18.31 miles per hour. The result of one hour's trial was 1,695 mean revolutions per mile, giving an average speed of 18.06 miles per hour, or more than a mile in excess of the contract number of miles it ought to have made. The design was wonderfully light. That was obtained by no unnecessary material being used. I had an opportunity to closely examine the engines and the boats in all the stages of their manufacture, and I have no hesitation in saying the design was excellent throughout, and the workmanship could not be surpassed. The torpedo launch, as a whole, reflects the greatest credit on the firm of Messrs. John I. Thornycroft and Co.

Captain COLOMB, R.M.A.: I should like to ask one question, and that is as to the coal-carrying capacity of the several vessels described by the lecturer; and also the amount of fuel consumed per hour.

Captain SMITH: I should wish to ask Mr. Donaldson the distance which these torpedo vessels would require to turn in at full speed; and also the distance they would run in slowing down from, say, a speed of 18 knots to a speed of 10 knots, as they would be longer under fire in going at a slower rate of speed. If you were pursuing a vessel going nine knots an hour you could not come up alongside her at full speed.

Commander LAW: I should like to ask whether that vessel can turn the helm hard over—the torpedo being lowered in its position for striking—without doing any damage to any of the machinery connected with the torpedo?

Captain SCOTT, R.N.: It is extremely difficult to speak on such a paper as we have just heard, unless one makes some comparison between our present war ships and the relative position and capabilities of the Thornycroft torpedo boats.

The value of our ironclads depends first upon their gun power, and secondly upon the strength of the armour which protects them; but if the gun power be small, the guns not very accurate, or the aiming of the gunners be imperfect, then the large amount of fighting efficiency which we might anticipate from ironclads is neutralised.

The lecturer told us of the difficulty experienced by marksmen in hitting the running deer target at the Wimbledon competition; but, notwithstanding this, I feel sure that by carefully selecting and training special men, a far greater result might be obtained in firing at sea than is now reached.

As regards naval guns, we have continued the use of studs up to this time, and consequently have only obtained a very low velocity of projectile, combined with inferiority in accuracy of fire; and now, at the last moment, we are hastily changing from studs to wads, a means of rotation which will not admit of a sufficiently sharp spiral of rifling to give steadiness of rotation to the projectile.

The result must be a want of that precision of fire which has become so necessary to repel boat and torpedo attacks with small guns, and to pierce the cuirass of an ironclad with the heavier ordnance.

The increase in the range and speed of the fish-torpedo is in some measure due to its being fired under water from an air chamber, from which it issues with some velocity, and is then projected onwards by its own engines, driven by compressed air.

Whitworth's fluid steel, from which the torpedo has been recently made, enables the very high pressure of 1,000 lbs. or more to the square inch to be obtained, the result being that instead of the original comparatively poor weapon running at about 12 knots per hour, which is below the speed of some of our ironclads, the missile starting from the air tube is now propelled with so high a velocity as to enable it to outstrip a swift Thornycroft boat for a short distance.

Another important improvement consists in the power of discharging the fish-torpedo from some distance above the water level without impairing the straightness of its run, and hence the missile can now be used by small vessels with far greater advantage than it can be launched from an ironclad.

The operator on board the Thornycroft would have a clear view all round the horizon, and hence would be enabled to discharge the fish in any direction, taking care there was no chance of a friendly ship's crossing its line of advance during more than 1½ minutes occupied by this torpedo in running 900 yards.

The operator between the decks of an ironclad or other heavy war vessel would have a very limited view, and be only able to train the torpedo on its carriage 15° or 20° each way, and hence would have far less opportunity than the operator on board the Thornycroft of discharging the "fish" at the right moment.

The carriage and use of so delicate a weapon on board an ironclad, and costing half a million, with a crew of 400 or 600 men, is of doubtful advantage, for should its air chamber or the 60 or 120 lbs. of gun-cotton carried in its head be struck by an enemy's shell, the blowing up of its deck, or even still more serious damage might ensue.

There is a further danger attendant upon the use of a torpedo in a squadron,
VOL. XXI.

resulting from the awkward tendency of this missile to take a curved course before it has reached its extreme range of about 1,000 yards; but should the tail or the machinery become damaged, the torpedo might return like a bomerang, and even blow up the vessel which fired it. I am pointing out the great care and the very skilful handling required, with the view of indicating that the fish-torpedo can be more advantageously handled by the picked crew of a Thornycroft than on board one of our larger war vessels, where an accidental blow might cause an explosion.

On the other hand, in addition to heavy ordnance projecting explosive shells with high velocity, the ironclad should carry some perfectly accurate and quick working light guns so as to destroy an enemy's gun and torpedo boats, two or three thousand yards beyond the *extreme range* of the fish torpedo.

There is, however, another weapon, which, from its long range and high velocity, seems likely to play an important part hereafter. I allude to the almost forgotten Hale rocket, which is a comparatively safe missile, and which, if its powers were developed with half the care and skill which has been bestowed upon the fish, would soon become a flying-fish torpedo through air and water. This rocket could be discharged at least 5,000 yards through the air (carrying a large bursting charge) with a rapidity little less than that of the rifle projectile. The cost of the Hale rocket would be far less than that of the fish-torpedo. The reason Mr. Hale did not proceed further appears to have been owing to the difficulties he experienced in the manufacture of the small rocket; these difficulties have now passed away, and had Mr. Hale lived he might now have been able to give proof of the value of the war rocket as compared with the gun as a means for destroying life.

We are no longer satisfied with killing one man at a time, but we want to blow up 500 at once, and instead of rejecting, as our fathers did, the employment of explosive bullets, we now seek to obtain the most fearful destructive agents with which modern research can supply us.

Another point I wish to bring before the many gentlemen present who have given attention to the subject is, that Mr. Thornycroft's boats work with a mean pressure of about 80 lbs. to the square inch; but I can see no reason why a boiler pressure of 500 or even 1,000 lbs. to the square inch should not be used in suitable boilers. The present boilers of our war ships are large steam reservoirs, which the bursting of an enemy's shell inside, would convert into a mine; but if, instead of bringing together such vast quantities of water and steam, the boilers consisted of a large number of encased tubes, on Mr. Perkins' plan, you might safely work at a very high pressure without incurring the risk of a fearful explosion.

High pressure not only affords the means of increasing the speed, but it is also very economical as to consumption of fuel, and this is a very important consideration, seeing that our ironclads can now only carry coals for five or six days' full steaming.

Experiments with the Perkins boiler have been long since officially recommended, but no trials have as yet taken place. Had such trials been carried out, I think Mr. Donaldson would have been able to have brought before you a higher result as to speed, and have answered the question as to the coal supply carried by his boats more satisfactorily than he can now do. Full speed is only needed in the act of attacking an enemy, and naval men know that these swift boats need sail to supplement their coals, and, like larger vessels, will need floating or other depots from which to replenish their fuel when employed at a distance from their own ports.

Commander W. DAWSON, R.N.: We are engaged in discussing the most important naval question of the day, and not a single officer on the active list has got up to speak upon it, and draw attention to that fact as one which frequently occurs in the United Service Institution, and is a sad contrast to what occurs whenever any professional subject connected with the Army is brought forward, for then we have distinguished generals on the active list, able colonels, majors, and captains vying with one another in discussing professional subjects boldly and intelligently, without fear or affection. I venture in the name of the active officers of the Navy, who cannot or dare not speak on professional themes, being myself on the ineffective list, to return the thanks that are due on the part of naval officers to Mr. Thornycroft, for the very wonderful way in which he has developed the speed of these very small vessels, and I may also venture in their name to return thanks to Mr. Donaldson for the very exhaustive and instructive paper he has given us. I came into this room

expecting to criticise the tactics suggested for use with these vessels; but as the paper progressed, I found the wind taken out of my sails, and that many of the things I had heard in connection with the tactics suggested for adoption by these torpedo boats had certainly not appeared in the paper. My own feeling is that the safest way for boats to approach armed ships is stealing up under the stern, or down under the bows, or getting alongside from any arc of the horizon, except the broadside of the enemy, and exploding the charge whilst alongside. The point we have to bear in mind is, that if the torpedo be held at a given distance of safety from your own boat, and be brought within destructive range of the enemy, the boat may lay alongside the enemy's ship whilst blowing her up. But in order to enable you to do so with the greatest destructive range, the charge appears to me to be insufficient. The charge is quite sufficient, it is true, to penetrate the bottoms of any ship, if it be exploded in actual contact; but the point I am contending for is, that it ought not to be necessary that the charge should be in actual contact, for the difficulty of getting into contact is so great, that you are obliged to run the great risk of approaching from under the stern, or from under the bows, or exploding whilst lying alongside. If the dimensions of that spar-torpedo were to be increased by a very small diameter, one inch or two inches, you might double the amount of charge, and the effect of doubling the amount of charge would be, that the effective destructive range would be increased. We know the effective destructive range of dynamite, and those powerful rapid explosives, is much less in proportion to their explosive effect than corresponding charges of slow gunpowder—that is to say, if 25 pounds of dynamite will, when in contact, do the same work as 100 pounds of gunpowder, then it would not do equal work to the equivalent charge when removed to the same distance from the object. When they are not in contact, equivalent charges have not the same effective distinctive range. There would be very little difficulty in the spar carrying double or treble; the charge and the result of that addition would be that you could operate against the bottom of an enemy's ship at a greater distance than at present. That is a very important point, because the destructive range involves a great deal of the tactics of spar-torpedo boats. Mr. Donaldson spoke of this nation being rather slow in adopting special vessels. The British Navy has a very wise prejudice against special vessels that can only be used for one special purpose, because such vessels are quite sure to be at the wrong end of the world when they are wanted. Just now it is not at Portsmouth, but at Gibraltar or the Grecian Archipelago that such vessels are likely to be wanted. Is there any difficulty in adapting these vessels for the ordinary purposes of war? For once that the British Navy is able to use a torpedo for blowing up a vessel, it is able to use a gun a hundred times. Is there, then, any reason why the decks should not be so strengthened in one part that a gun could be mounted on the other deck, and thus these boats might be made use of for river service and for the service for which small gunboats and steam launches are now employed? If we could use the Thornycroft vessels for such purposes, then there would not be the same objection to the British Navy receiving them for the use of torpedoes. That objection will stand a good deal in the way of their adoption in the British Navy, and if you can overcome it, then the difficulty in the Navy in receiving special vessels of very limited utility would be very much diminished.* Allusion was made to the experience of the American war. Well, we have profited a good deal by that experience. They were labouring under great difficulties in the matter of ignition on the Confederate side. They had only one mode of igniting spar-torpedoes, and that mode demanded contact being made nearly at right angles to the side struck, which necessitated the torpedo vessel approaching the enemy on the very worst possible position for her own safety—namely, against his broadside. The consequence was that when the "Housatonic" was destroyed, the torpedo boat ran at right angles to the broadside, and ran into her own explosion, and the boat disappeared, as well as the corvette. Nobody ever heard of her afterwards, and it was believed that the effect of her own explosion was the cause of her disappearance.

* It was subsequently stated that the Thornycroft boats could only carry coal for two or three hours' steaming at full speed. This obviously limits their utility much more than I was aware of when making the above remarks.—W.D.

ance. Then on the occasion on which Captain Davidson performed his remarkable feat, he failed to destroy his enemy entirely, because the charge was too small. That is a lesson that cannot be pressed home upon us too strongly. It is no use a boat running the great risk of bringing a torpedo near to an enemy's ship, unless the boat carries such a weapon as will be sure to do its destructive work without any doubt. Over-refinements in weapons of war are very objectionable. A great number of the Confederate ships were fitted with spar-torpedoes, but the reason why so little use was made of them was the difficulty arising out of the mode of ignition which required an approach to the enemy's vessel in a very exposed situation. With reference to the destruction of the Confederate ironclad "Albemarle," it will be remembered that the Federal mode of ignition was different, it was by trigger line. At the conclusion of Mr. Donaldson's paper he alluded to the experimental results of accuracy of fire with the Whitehead torpedo in the open sea, but he acknowledged that his knowledge of the accuracy of range of the Whitehead torpedo in the open sea was by hearsay. The danger connected with the Whitehead torpedo is that the path is invisible to friends as well as foes, and during the time which elapses between the torpedo leaving the ship that forces it, and reaching its intended destination, when squadrons are intermingled in the fray, some friendly vessel may very easily but unknowingly intercept the invisible torpedo, and you may then blow up your friends instead of your enemies. When several moving vessels are rapidly launching successive fish torpedoes against moving vessels the danger is greatly multiplied. That seems to me a very formidable objection to turning adrift a number of invisible weapons like the Whitehead fish torpedoes in squadron actions at sea.

The CHAIRMAN: With the permission of Mr. Donaldson and of the meeting, as I was on board the "Lightning" I may be allowed to mention two practical points which occurred to me, and which are not contained in the lecture. In the first place, I do not think Mr. Donaldson has pointed out that the very high rate of speed attained in these boats is due to the fact that the screw shaft is level with the keel, and that the semi-diameter of the screw propeller is in addition to the draught of the vessel; that by that means she develops a larger power through a very much larger screw propeller than any other vessel has yet obtained, and obtains immersion in that way which is of great value. There is another point—namely, the curious fact that the additional speed is obtained by the vessel herself being forced out of the water; and that after she begins to go at the great rates of speed, after 14 knots, she is drawing something like three inches less water. I think it would be interesting to the meeting to have some information upon that point. Up to the 12-knot speed the "Lightning" was followed by a wave higher than herself at a very short distance astern; but when the speed increased to 16 knots there was no wave at all, the vessel herself was forced out of the water—like a skimming dish on the top of the water. And, in addition to that, the vibration which at 12 knots was considerable, entirely disappeared at 18 knots. I believe it will be interesting to have some more perfect information upon those two points. There is another point it would be desirable to know, and that is—what number of torpedoes can a vessel of that sort—such as the "Lightning"—carry for service. There is also another very interesting point, I do not wish Mr. Donaldson to go into the items of the firm, but the cost is an element with which approximately, perhaps, he will be kind enough to favour us.

Lord OTHO FITZGERALD: One matter that has been overlooked is with reference to the fouling of the screw; that is the only objection that occurs to me to these torpedo boats. For instance, if a few old herring-nets were hung round with buoys in the water at half a fathom deep, I do not think any torpedo vessel could pass them; any such matters as old herring nets or old ropes held in the water would so foul the screw that her progress would be entirely stopped. Perhaps Mr. Donaldson will say whether he contemplates any means for avoiding such a casualty.

Mr. DONALDSON, in reply, said: Mr. Olrick mentioned that no sparks came from the funnel in the case of the Scandinavian boats. That is so; but in the French boats we had some sparks, and that is the reason why in the new French boats provision is made to prevent them escaping. Captain Colomb asks about coal-carrying,

and I think I am right in saying the Scandinavian boats used about six or seven hundredweight in the hour's run, and the French boats about a ton in the two hours; but in running for a long time a great deal of the coal is thrown up the chimney, so that you can scarcely get an idea of the efficiency of the machinery of these boats from the amount of coal used. In ordering their boat, the Norwegian Government stipulated we should carry coal for above a two hours' run; the French Government stipulated for three hours, and in the new French boats there is three hours' supply. The "Lightning" carries five tons of coal in her bunkers, and two and a half tons was found quite sufficient to take her round from Chiswick to Portsmouth. We have no very accurate information about the coal-consumption in our boats. Captain Smith asks the distance in which the boat could turn at full speed with the screw aft the rudder. This distance is greater than in ordinary boats, as we cannot put the rudder hard over suddenly, because the rudder on being put over makes a vacuum, and the engines get away too fast. It requires to be done carefully, but I should think that at Cherbourg, on running round the breakwater, we did it in about a quarter of a mile radius going at full speed. As to stopping we can stop dead from 18 knots in about the length of the boat in any of them. Commander Law inquired if we could turn the helm hard over with the torpedo lowered into position without doing any damage: I cannot say, as we have never made the experiment. Captain Scott asked about the safest torpedo: when I said the Whitehead torpedo was considered the safest I spoke of the opinion I have heard officers express regarding it. They seem to think the Whitehead is a safer torpedo to use than the other, on account of their not requiring to go alongside with it.

Captain SCOTT: Safe as respects the officers using them not being obliged to come under fire.

Mr. DONALDSON: Yes. The Hale rocket I should think would be well adapted for our boats, because there would be very little recoil on the rocket leaving the boat. We use 120 lbs. pressure in our boilers, and if Mr. Perkins' engines and boilers could be made as light as ours I do not know why we should not use them; but I think they are heavier than we make them, as a rule, and we have always the carrying consideration to look to. With regard to the sails in those boats, there were some sails reported as having been used on the French boats, lateen sails, and some French newspapers went the length of giving the dimensions of those sails. These, however, were only newspaper reports. There were no sails at all; I suppose the torpedo spars were taken for sails. Captain Dawson spoke of coming alongside, and the effect of distance on the explosion. I believe there was an experiment made in Sweden with 32 lbs. of dynamite fired three feet from the side of a section of a vessel representing our "Hercules." The explosion sent a hole nine feet by three through both bottoms, the inner bottom being three feet distant from the other, and the torpedo being three or four feet off. I cannot say much about this question, however, as we only build the vessels. We never made experiments with the torpedoes. About the difficulty of adapting our vessels for carrying guns, we have fitted some of our small boats for 9-pounder guns, and I should think small guns of that kind could be carried easily; but in mounting heavy guns of course you require heavy carriages, and I think my partner would object to putting such heavy weights in our small boats. With regard to the submarine vessel that sank the "Housatonic," I think I have heard it said that that vessel was recovered and is now in the Museum at Washington.

Captain McEvoy: She was recovered about three years after the war. The divers went down and found her lying alongside the hull, with the remains of the nine men that were in her.

Mr. DONALDSON: I should say the vessel would certainly be destroyed by the effect of the explosion, because it would be all round her. I do not think there would be much chance of it escaping.

Captain McEvoy: It was a sort of submarine boat, so constructed as to be able to come to the surface and to go down at pleasure, and to stop down a certain length of time under water. But, however, she had drowned several men in experiments before she went out that last time. She had drowned a crew of nine men just previously, but notwithstanding that they found a crew very readily to take her out the last time.

Mr. DONALDSON: With regard to the Whitehead torpedo experiment, the only ones I have seen are those in the canal, at Woolwich and at Fiume, where they seemed to go very straight. Sir John Hay asks what is the high rate of speed due to. It is due to everything—a carefully designed light hull, carefully designed powerful engines, and to a certain extent to the large screw area. With regard to the boat being lifted out of the water, there was a very interesting paper read by Mr. Thornycroft at the British Association in 1875 on this subject. The experiments were made on the 67-feet Austrian boat, and she certainly was lifted.

Mr. THORNYCROFT: At 11 or 12 knots the boat was depressed in the water five inches below its ordinary line of floating; but on the speed being increased to 13 knots, the boat floated at about three inches above the ordinary level. I might further be allowed to add, in the experiments made on the "Lightning," I expected a similar rise above the ordinary floating level; but so nearly as I have been able to make out from the experiments made, the boat did not rise perceptibly above the ordinary floating level, although there was a corresponding depression of the centre of gravity of the boat at the lower speed, which corresponded to the 12 knots in the smaller vessels. This discrepancy may be due to imperfect observation, but the experiments on the Austrian boat were made in shallower water; and the different conditions in which the experiments were made, due to depth of water, may account for the apparent discrepancy.

Mr. DONALDSON: The number of torpedoes that can be carried is simply a question of weight. The French boats were fitted with two each, and the Norwegian boat with one torpedo, and the Danish boat with two torpedoes. I think the "Lightning" will be fitted with four, but I am not quite certain. With regard to the cost of the boats: the cost of the Scandinavian boats, without torpedoes, was £1,800 each. If I remember rightly, the cost of the 67-feet French boats was £3,400 each; the cost of the Dutch type of 76 feet length was £4,750; the cost of the "Lightning" £5,250; and the cost of the new French boats is £5,500. These prices are, however, complicated by the fittings on board, the torpedoes, delivery, and such like questions. Lord Otho Fitzgerald asks if herring nets would stop the torpedo boats. I think I have heard Mr. Thornycroft say he has gone through a bed of osiers with his weed cutter, so that probably the weed cutter would cut the nets as well as the osiers.

The CHAIRMAN: It only remains for me to convey the thanks of this meeting to Mr. Donaldson for the very valuable lecture he has given us. The next information we ought to have, as sailors, is how we are to defend ourselves from these vessels.

NOTE BY MR. LOFTUS PERKINS.—The Perkins engines and boilers need not be heavier than those used by Messrs. Thornycroft in their torpedo vessels, if specially designed (as Messrs. Thornycroft's engines are) for the special purpose; and, for heavy war ships, Perkins' engines and boilers would be lighter for the same power than those now used in ships of war.

SPECIAL LECTURE.

Monday, May 28, 1877.

General Sir WILLIAM J. CODRINGTON, G.C.B., &c., &c., &c.,
Vice-President, in the Chair.

A VOLUNTEER FORCE, BRITISH AND COLONIAL, IN THE EVENT OF WAR.

By Colonel H. C. FLETCHER, C.M.G., Commanding 2nd Battalion
Scots Guards.

It has been somewhat difficult to find a heading for this paper that will explain the views that are intended to be set forth, and therefore I may as well say that the scheme which I propose to bring under your notice this afternoon, is one for subsidising an expeditionary force of regular troops (supposing such a force should ever be necessary) by representative bodies of our volunteers, drawn not only from the mother country, but from her great colonies. I do not venture to propound this plan otherwise than to provoke the criticism, and to draw forth the opinions of the experienced soldiers who would be called upon to command and to organise our forces in the event of war, as well as of those who, brought into contact with the class that compose the strength of our volunteers, will be able to speak authoritatively of its desirability and even of its possibility. The difficulties that may attend it are doubtless great, the objections to it are probably numerous, but if there be a germ of practicability about such a scheme the sooner this germ ripens into fruit by the assistance of friendly criticism, the better it will be, and if there be no reality about it, the quicker it is consigned to the limbo where ill-digested and useless plans lie, the better it will also be.

Before attempting to set forth any details, I must, in order to defend the position I intend to take up, endeavour to lay down a few general principles. Owing to facility of communication, denseness of population, and the power that mechanical skill has afforded of arming, supplying, and transporting vast numbers of men, and of providing unlimited quantities of material, the armies now placed in the field are far larger than any that have ever been organised in former

periods of European history; whilst in place of fighting their battles with troops removed for long periods of service from civil life, continental nations vie with each other in sweeping into the net of conscription the larger portion of their male population. Happily our insular position enables us to avoid (at all events for the present) this method of converting nations into armed camps, thereby sapping their energies and rendering war almost preferable to armed peace. We are content with a comparatively small army raised from what I must call—in fault of a better word—our poorer classes, and to supplement this army by a militia also formed from similar materials, and by our volunteers, who furnish an outlet for the military instincts of the middle strata of our society; whilst we leave our great colonies to manage their own affairs, without endeavouring to unite them in any imperial scheme of mutual defence—gradually, and by a method peculiarly our own—of improving, without revolutionising—we are bringing together a portion of these heterogeneous bodies into something like a cohesive force; but war may not wait for the perfecting of our plans, and we may be called upon to take the field before our organisation has advanced beyond its elementary processes. For merely defensive warfare, plans have doubtless been prepared, and the recent mobilisation scheme shows that the utility of what are called our auxiliary forces has been partially recognised. But when has England waited to be attacked? Has she not interests to guard beyond the four seas; outposts to garrison, on the defence of which the vitality of our Empire depends; and even a policy to support that may lead to our selecting for the seat of war, a foreign country rather than our own fields. For such a war, expeditionary forces proportionate to the strength of a mighty nation will be necessary, and every energy will be taxed to supply means for rendering them sufficiently powerful to meet the hordes that conscription has enabled our continental neighbours to place under arms. Our regular troops will be augmented, our militia mobilized and increased in numbers, and all the inducements that pay and bounty can afford will be tried, to swell the ranks and supply the needs of our army and of our navy. But how can we compete with the product of the wide net of conscription, through whose meshes so few fish can escape, unless we utilize our middle classes, and avail ourselves of at least a small portion of the vast organisation that has placed so many of them under arms? Why also should we not welcome among our first line, the sons of those enterprising men who have extended the influence and power of England through so many distant lands, and have inherited with the warlike instincts of their race, the loyalty that would impel them to great sacrifices, in the event of danger to the country that they still look on as home?

Since the last great wars of the French revolution, the total population of England has not only increased enormously in numbers, but the middle class which now forms the bulk of our volunteer forces has augmented in an even higher ratio. The threat of invasion in 1859 called forth its warlike instincts, and gradually but steadily, the organisation it adopted has risen in efficiency, and the force has shewn itself

more and more alive to the reality of the work that may possibly await it. There are doubtless great differences in the efficiency of regiments; but the majority of those Officers who have had opportunities of commanding brigades composed of volunteers will I feel sure bear evidence of their discipline, and aptitude to learn, and of the willingness with which they will make sacrifices for the sake of instruction in their military duties. The liking for display and for what may be called the showy externals of a military career, have in great measure given place to a sense of the reality of their work; and the more this reality is brought home to the members of the force, the greater will be their zeal, and the higher their standard of efficiency. It is well understood in all countries, that to keep a picked body of troops, such as those that do duty as guards to the sovereign, up to the proper mark, the feeling that in times of danger, they will be the first to be sent on service, is of the most vital importance, and on a somewhat similar principle the dangers of active service ought to be faced by the peculiarly constituted force represented by the English volunteers. War is a great leveller; distinction of class, advantages of social position, the possession of wealth, and of the capacity for enjoying it, all vanish before the exigencies of service, and the very fact that the volunteer regiments include among their rank and file, men of a higher social grade than the regulars and the militia, points to the desirability of giving them opportunities of facing danger, and of showing that they are worthy of the advantages that Providence has bestowed upon them. That this feeling exists among the members of the force is evidenced by the increased impetus that even a vague prospect of service gives to their recruiting, and by the additional and self-imposed work which many of the Officers and men undertake when war on the continent shows even a slight chance of military employment. What the French describe as the baptism of fire, applied even to a small portion of the force, would do more to increase the popularity and raise the standard of the volunteers, than years of drill and preparation. It would augment their prestige, would create traditions of danger faced and of glory won, and would stamp on them a reality which subsequent years of peace would fail to efface. I think that it is hardly necessary to pursue further this portion of the subject, the fact is so indubitable that few will be disposed to question it, and if I may be allowed, I will assume that solely with the object of elevating the *morale* of the volunteers, the advantage of employing a portion of the force on the first opportunity that war affords (putting aside for the present all difficulties in carrying out the plan) is indisputable, and may be taken for granted.

There are, however, other aspects of the question, which naturally occur to all who think it over. In the first place would a force composed of volunteers be able at the outbreak, or soon after the outbreak of hostilities, to take its place with regular troops? To this query I can well understand that many Officers who have experience of soldiers, will feel some difficulty in giving a favourable reply. They know how long it takes to make an effective soldier, and how gradually discipline becomes inculcated into his mind by the daily,

strict, routine of drill and duty. From much experience, they are aware of the constant attention and careful supervision which the raw recruit requires to convert him from the yokel to the smart soldier, and they view with suspicion the royal road to learning which they think the volunteer is aiming at. These objections are well worthy of consideration and afford much scope for thought; but on the other hand the end in view must not be forgotten in testing the means employed, and the lessons of history ought to be carefully criticised and then duly appreciated. The aim of all military training is to produce a body of men who will face hardship, danger and death without question and without flinching. The ordinary weaknesses of the flesh have to be subdued by other impulses; and as the body is strengthened by exercise, so must the moral qualities of the soldier be fortified by the stimulants comprised in the comprehensive term of discipline, whilst his own self-reliance must be augmented by the belief that he is supported by men actuated by similar motives.

But men are differently constituted, and although in peace time, and having regard to the ordinary type of recruit, we grind all in the same mill, yet it does not follow that there may not be a shorter way of attaining a similar result. Among the numbers that compose the volunteer force, there must be many men who are imbued with a large share of what may be termed military instincts, but who are debarred by their position in life from taking service either as private soldiers, or as Officers of the regular army. These men voluntarily attend many more than the prescribed number of drills, they also view their work in a more practical light than others who go through it in a perfunctory manner, consequently they are far in advance of their comrades, and are frequently on a par with men who have engaged exclusively, at all events for a few years, in a military career. To these men the prospect of active employment would serve as a powerful incentive for renewed exertions. Their education, the feeling of responsibility which their status in society gives, and the additional stake they possess in the country, would all act as stimulants to enterprise, and would more than counterbalance the absence of a portion of the professional training which an ordinary recruit receives. Surely a brigade of men such as these, chosen from among the best volunteer regiments, of high physical qualities, and brought together, say for a fortnight's training under some energetic regular Officer, would be welcomed by any general of division, and would be infinitely preferred to the foreign mercenary levies who augmented the numbers of the English Army at the close of the Crimean war; good as those troops doubtless were. And here I would observe that it appears to me unworthy of a great nation to fight its battles with troops that have nothing in common with it except the pay they receive, whilst it leaves untapped the mine of wealth that its middle classes present. Without doubt we have pursued this course in former wars, but it must be remembered that the principal recruiting grounds for mercenary troops is now more than occupied by a great military nation, that has too much employment for its own sons, to permit of their giving military service to other countries. Besides this, in the

Peninsular war, we fought the battle of oppressed Europe, and so drew into our army those, who, hating French rule, were consequently unable to remain in their own homes, and therefore took service in our army.

It is a comparatively modern idea that battles are to be fought by men trained exclusively for war, and that the mass of the nation is to look on whilst its life and honour are defended by a portion only of its representatives. In the ancient republics of Greece and Italy, it was the duty, and even the exclusive privilege of the citizens to bear arms, and not until the decline of Roman liberties, did paid legionaries take the place of the levies of the free inhabitants of the great city. Conscription, properly enforced, compels all classes to bear their share of military duty, and those armies have been most formidable that have included in their ranks representatives from every portion of the nation. The troops of the French Republic which the Great Napoleon led into Italy, the German army that conquered at Sadowa and at Sedan, were types of the nations they fought for, being composed of every element of which they were formed. Excellent as the English regular army is, it yet lacks the elasticity which gives scope for all the warlike energy of the people; and when a serious war tries the nation, a loss of strength will ensue unless every class pays its share of the blood as well as of the money contributions.

I have now endeavoured to establish two theses: first, that a representative body of volunteers in a military expedition beyond the seas, would be of great service to the force itself; and secondly, that they would add to the strength of the army of which they would form a part, whilst, indirectly, both as benefiting the volunteer force, and as bringing prominently to the front the middle classes of the community, they would materially increase the fighting power of the nation. It now remains for me to endeavour to indicate how such a force might be raised, and here I must ask for the indulgence and forbearance of those who are so much better acquainted with the subject than I am, presuming on the fact that sometimes the ignorant, from a want of knowledge of difficulties, may strike out a line which those who are brought face to face with them, cannot venture to pursue. In a discussion on the recent mobilization scheme, and the place allotted to the volunteers in the defence of the country, I heard a distinguished colonel of one of the best metropolitan corps make the remark that he quite approved of the force being at first placed in fortresses or entrenched positions, as he felt sure that if they were subsequently found fit for the field, the generals in command would be too glad to have them. Mr. Hoste, in the able paper which he read at this Institution,¹ pointed out the desirability of dividing the force into a first line and a reserve; and this idea has been advocated by Lord Elcho, and I believe already partially carried out in so far that the force of some of the regiments is strengthened by a register of men who have passed through the ranks, and who are willing to serve again in the event of war. I would propose to enlarge on this scheme, and endeavour in peace time to provide for an organization that might be utilised in providing a force ready for immediate war. In every regiment of

¹ For lecture, see page 799.

volunteers a roll of men might be prepared who would be willing in case of hostilities to serve abroad, say for a limited time; these men should pledge themselves to attain to a higher pitch of efficiency than their comrades, by attending a larger number of drills; they should be passed as medically fit for service, and should be certified as being effective soldiers by the Inspecting Officers at the yearly inspections of the regiments. As there are about 165,000 enrolled and efficient infantry volunteers, two per cent. would give a force of upwards of 3,500, or very nearly a brigade; whilst if a really popular war should break out, and (with the present extension of the franchise) no war not popular could be undertaken, this number would be rapidly increased. It may be objected that under the most favourable aspect the force raised would be small; but as I have already endeavoured to point out, mere numbers do not measure its real value. The yeast that leavens the dough is insignificant in quantity, but its effects are unmistakeably great, and the first expeditionary force sent abroad would in all probability form the nucleus of considerable reinforcements as the nation warmed to its work, and as the strain of war closed many of the outlets for labour, which peaceful civilization opens for the middle classes of society. For it must not be forgotten that a serious conflict would necessitate great sacrifices and many economies, and that those who minister to the refinements of life would find less demand for their labour. There are, also, in all vigorous communities many young men whom the prospect of military service arouses from idleness and pleasure, and who would willingly engage in a force where they would find friends and companions of their own condition, although they might be unwilling to embrace a purely military career by enlisting into the regular army; for although it may be said, that if these young fellows are so fond of soldiering, they had better take service in the ordinary way, the fact remains that they will not do so. Even among the most military nations, where conscription is the law of the land, some escape is afforded to the sons of the gentry by means of a cadet service; and I think few will be prepared to say that, except under the pressure of the most imminent danger, the sons of our gentry, of our tradesmen, and of our farmers, will enlist in any large numbers into the regular army or the militia. We must deal with facts as we find them, and I am inclined to believe that this is a fact that few will be prepared to contest.

Supposing it were possible in peace time to form any approximate idea of the numbers of a force raised from the volunteers, companies might be organized on paper from regiments that have an affinity to each other, and the proper Officers nominated to command them. Certain regiments, either from social similitude or from local influences, establish ties which it might be well to recognise, and so whilst providing for uniformity in the total force raised, some consideration might be given to the inclinations of the volunteers in the divisions of the brigade into battalions and companies. To guard against the interference that the organization of such a force might cause to the recruiting for the army and the militia, and to the possibility of ambitious men raising companies and regiments to obtain commis-

sions, I would forbid any but efficient volunteers being enrolled in it; so that at the outset of hostilities the brigade for service would be selected solely from those who had made themselves efficient members of their corps during time of peace.

A notable instance of a large portion of an army being raised from a class similar to that which forms our volunteers, may be found in the troops of the Southern States of America that commenced the war with the victory of Bull Run. There, might be seen companies raised by wealthy men, who recognizing in themselves a want of military experience took service in the ranks, whilst the private soldiers came into camp attended by their slaves, who, exempt from military discipline, enjoyed more freedom than their masters. As the war developed into larger proportions, those who survived the first battles returned with the experience gained on service and raised fresh companies and regiments, which they were able to command as Officers and non-commissioned officers. And thus the country benefited not only by the example set by the upper classes, and by their actual fighting powers, but by the training afforded to men who in other respects were well qualified to serve as Officers. In a minor degree (as the war at its commencement was less national) the Northern States furnished regiments composed of men who could compare with those who fill the ranks of the best of our volunteer regiments. I have frequently seen a regiment from New York (recruited from what may be considered a wealthy class) engaged in some of the hardest work of a siege, and it certainly was not among such troops that breeches of discipline occurred. In neither of the instances quoted, had however the volunteer regiments the advantage of serving side by side with regulars, a defect in organization inseparable from the constitution of the American armies, but one which led to terrible disaster: for I would insist with great stress on the necessity for this description of force being limited to a small proportion only of the army. After months of drill and of discipline, the proportion might doubtless be increased, but nothing can compensate for any want of the elements of stability, which discipline, training, and, I may add, professional instincts, can alone insure.

For the regimental Officers of such a force, I would provide in the same way as for the men, only greater care should be taken in their selection. Not only should they be well instructed in drill, but they should be men known in their regiments as possessing power of command and qualities that would bear the test of actual service. If they have had the advantage of training in the regular army, so much the better; but there are qualities which no training can give, but which seem to be born with men, and which are instinctively felt by those who are brought in contact with them. The field of selection would probably be large, as the number of Officers required would be but few, and in the event of active employment, no hesitation should be felt in summarily getting rid of any who might be incompetent. The less highly trained a force is, the better should be its Officers. There are many men who can command creditably a regiment in perfect order, and possessing all its proper links of responsibility: but there are but

few who can lead and impress a character on a force such as our Indian irregular regiments. I use this example as the nearest at hand, and as serving to describe the class of men to whom should be granted the privilege of officering a force such as it is proposed to organize. There would, I believe, be little difficulty in finding properly qualified men for this responsible position. In the volunteers are many ex-Officers of the regular army, who have seen service in the field and who are young and energetic; and although, as I have just said, this qualification should not be insisted upon, it should still carry considerable weight, and should constitute a claim for selection provided other requirements were fulfilled. Similar arguments would apply in a minor degree to the non-commissioned officers, but as in all probability several of the young men who would enrol themselves would already hold that grade, although prepared to resign it and to serve as privates, there would be a considerable scope for selection on the assembly of the force prior to embarkation.

It may, perhaps, be contended that the regiments would lack cohesion, that men would not know their Officers, and that it would take a considerable time before the units could be welded into a cohesive mass. But it must be remembered, that I am speaking of a time when a prospect of war would add an indescribable stimulant to exertion, and when, consequently, as much could be done in one day as in a week or month of ordinary life. I am also taking for granted that the ingredients of such a force, selected from so large a body as the volunteers now are, would be of no common order, and that each and all being actuated by similar motives, the fortnight or so in camp or in barracks previous to embarkation under an energetic staff, would be able to work wonders. The system of drilling regiments of volunteers in brigade, would give the opportunity to men of becoming acquainted with each other in peace time. The young fellows, whose names were enrolled as willing to serve in war, would soon be known throughout the brigade, they would probably be inspected together whenever it assembled for drill, and thus the men of the companies would not be strangers to each other. A few days in a transport, and a still fewer before an enemy would cement the union already formed, and would create ties that years of peaceful life would fail to form. A similar objection may also be found to apply to the regular army, when regiments for embarkation are often swamped by draughts of men totally unacquainted with each other or with their Officers. It can, therefore, be overcome, especially under the favourable conditions of a force composed as that we are dealing with, and I think the difficulty may be regarded as more ideal than real.

A place would, of course, be indicated for the brigade to assemble at when war appeared imminent, probably near London or Aldershot, where arms, clothing, and equipment would be served out, and where its organisation, previous to embarkation, might be completed. It would be desirable that the uniform should be assimilated in all essentials to that of the army, and that the men once assembled, should, in every respect, be dealt with as regular soldiers. There would be no difficulty in discipline if the reins were in proper hands, as

most of the ingredients that conduce to it would be present in full force. *Esprit de corps* would be very strong. Education and intelligence would enable men to comprehend the meaning and necessity of orders, and all would feel that not only was the honour of their regiment and brigade entrusted to them, but that they were the representatives of the 185,000 volunteers from whose ranks they had been picked, and who were themselves, in all probability, making ready to take their part in the defensive organisation of the country; and were, consequently, watching as soldiers the behaviour of their more fortunate comrades. I can conceive no more favourable conditions for inculcating discipline and for completing organisation. How such a force should be managed, trained, and brought into the field can be studied in the recently published and most interesting memoirs of the Count de Segur, where, as the close of the great struggle, that—following the retreat from Russia—culminated in the battles before Paris, that admirable Officer was ordered to raise, organise, and equip regiments of young men drawn from the royalist families of Normandy and Brittany. How he succeeded and how these regiments proved in action the value of their training will also best be learnt by a perusal of the same volumes.

It is scarcely necessary to say that the force proposed to be raised from the volunteers should be treated in every way whilst on service as regular troops, they would be under the Mutiny Act, and would receive the regulated pay and allowances. In fact, whilst serving they would be regarded as regular troops, only I would venture to suggest that if they proved fit for duties in the field they should be pushed well to the front and not left in garrison. This privilege, I think, they might venture to ask for, and I doubt whether any jealousy would be created by according it to them.

I have now briefly, and I fear incompletely, brought under your notice the first part of the scheme, which is comprised under the heading of this paper; but before discussing the second portion of the subject, I would desire to answer an objection that I foresee may be made. There are three great organisations that compose our army, the regulars, the militia, and the volunteers, and it may be said that I am unduly exalting the third at the expense of the second. But to this I would reply, that one of the bases of my argument lies in the assertion that the volunteers represent a class in the community, which—unless conscription be enforced—is not found in either the regulars or the militia, and that it is to utilise this force and to give it additional vitality, that I propose to place a small portion of it in the first line; whilst I would quote (to strengthen my arguments) the great benefit that accrued to the militia from the sending of several regiments to garrison our fortresses in the Mediterranean during the Crimean war. If that war had continued and expanded, doubtless these regiments (excellent in every way, and by the training and practice they had had, fit to take their place in the field) would have been pushed to the front. The same result would, I venture to say, occur in any future great war, and the militia regiments need not fear lest they should be ignored, if—and this admits of no doubt—they

attain to the standard of efficiency which their comrades of 1855 and 1856 reached. There is room for all in a serious war, and wealthy England need not be afraid that she will be called upon to equip more soldiers than she can afford to bring into the field. I contend that she has never tapped a most rich mine, and that in place of subsidizing other countries and engaging mercenaries, she ought to utilise to the utmost her own children, especially when so many of them will be only too eager to fight for her.

To turn to the second portion of the subject, namely, the employment of a Colonial force to act with our regular army.

The facilities of communication, and the increased intercourse between portions of the globe separated from each other by what were formerly considered as vast distances, have tended to bring our great colonies into far closer union with the mother country than in past days. Time, has, in fact, been completely annihilated, and the instantaneous transmission of intelligence augments the interest that those who look on, have for those who are engaged in war; whilst rapidity of communication affords means of giving practical expression to their feelings of sympathy. The connection between England and Canada has become very close, every event is telegraphed, and if the occurrence of a fog in London affords a paragraph in an Ottawa evening paper of the same day, much more will any circumstance that touches on the interests of England find an immediate echo throughout the colony. A war in which England were engaged, would stir to the depths the feeling of loyalty and the love of home that are such marked characteristics of Canadians, and there would be a universal desire to do more than merely look on as spectators of any struggle in which we might be involved. A few days ago a telegram from Canada announced that a field battery at Toronto had volunteered for service in the event of England going to war, and it is probable that many other portions of the Canadian Militia would, under such circumstances, be eager to cast in their lot with the British Army.

Owing partly to a general belief that in consequence of the good feeling existing between England and the United States, and the peaceful aspect of affairs throughout the great Republic, no need exists of military preparation, the Canadian Militia has gradually been reduced in number, and I must say in efficiency. The last report shows that they consist of not more than 23,000 actually exercised during the preceding year, and the period of training extends only to twelve days for artillery and eight days for the other branches of the service. When I add that there is no permanent and paid staff of any description below a brigade major, a notion may be arrived at of the general condition of the force if measured by a European standard. "At the same time" (to quote General Selby Smyth's report) "it must be borne in mind that the active militia is but the "advanced guard of the Army of Canada in case a general call to "arms should ever occur. The real force of the country would then "be represented by the reserve militia amounting by law to some "600,000 men." From this larger basis of supply, the troops who

might enrol themselves for foreign service could be drawn, and it must be remembered, that although no portion of the force might be highly trained, the Canadians possess, in a marked degree, qualities calculated to make excellent soldiers. They are hardy, industrious, accustomed to rough work, and handy in dealing with the many exigencies of colonial life. They are also easily subjected to discipline, and willing to submit to the authority which they recognise as necessary for military efficiency. The various descriptions of labour in which they are engaged, and their habit of adapting themselves to different conditions of life, make them peculiarly fitted for many of the requirements of soldiers on service. In the Red River Expedition, under a leader whom they respected and admired, they performed excellent service, and the manner in which they overcame the many difficulties that beset their path through the wilderness, showed that in a very high degree they possessed the qualifications of excellent troops. During the Fenian raid, I have been assured on the authority of the Officer who so ably commanded the Red River Expedition, that their cavalry, under Colonel Denison, of Toronto (well known as a writer of a treatise on that arm) performed most valuable service in watching a wide extent of country, whilst the manner in which their field batteries work and manœuvre, gives a proof that the habits of driving so universal in Canada and the States, can be turned to good account for military purposes. In fact, there is no better material for making soldiers than is to be found in Canada, and I may add—if the maritime population of Nova Scotia and New Brunswick, and the semi-maritime navigators of the inland seas be taken into consideration—there would be found ample materials for adding to our seamen. That there is a warlike spirit in the country is shown by the popularity of the militia and the willingness with which they turn out on the prospect of anything like service. But peace tends to rust their arms, and the absence of any regular troops to furnish a standard of excellence, leads to a gradual diminution of efficiency. If, however, England should be engaged in war, and if the services of a few regiments of Canadians were asked for, I feel sure that the call would be warmly answered, and that a body of troops, which, in a short time would reach a high state of efficiency, would be ready to embark for service wherever they might be required. In accepting their services, Canada should be treated as an equal, the force ought to be taken with its own Officers, and if sufficiently advanced, the New Military School at Kingston should be utilised, to furnish a portion at least of the necessary staff. Possibly some regular Officer, known in Canada, might be appointed to the command, but the Colony should be encouraged to organise, equip, and officer its own troops. When once on board ship they would come under the Mutiny Act, and be paid by England, possibly, also, it would be well that a portion of their equipments and arms should be furnished to them by the mother country, but the political as well as the material benefit accruing from such a force, would, in a great measure, depend on its organization being Colonial, *i.e.*, that it should not consist merely of soldiers recruited and paid for by the mother country, but that it should be a

force placed at her disposal by a great colony, anxious to show that it recognised among the duties that a grown up child owes to its parent, —the noble one of contributing to its defence.

It is, of course, impossible to estimate what numbers could and would be sent, as they would partly depend on the popularity of the war, partly on the condition of affairs in the colony. It is also difficult to indicate the class of men who would volunteer for the service. The Canadian Militia have an affinity to our volunteers as well as to our militia, and the regiments vary greatly in their composition. Some are induced to enlist into the active militia by the pay—a somewhat higher rate than is afforded directly to our troops—whilst others engage from the love of the service and from the incentives of duty. There is also a great difference between regiments raised in the several provinces of the Dominion; and in regard to present efficiency much depends on the opportunities that the propinquity of the villages from which the companies are enrolled, gives for drill. Probably a force for foreign service would comprise regiments representing the various elements from which the present militia is raised; and if, at the first start, two regiments of infantry could be equipped in Ontario, one in Quebec, and one in the maritime provinces, with perhaps a couple of batteries of artillery and three squadrons of cavalry mounted on Canadian horses, an excellent commencement might be made for future organization. If this force distinguished itself before the enemy, which it would be well nigh sure to do, the prestige that it would afford to the Canadian Army would be very great, whilst the additional and noble tie that community of danger and suffering would furnish, would do more to bind the colony to the mother country than years of negotiations and of mutual arrangements. I can imagine no finer troops than could be raised from the backwoodsmen and lumberers, who seek a livelihood in the Canadian forests during the winter months, and who, when the freshet or spring liberates the waters, are engaged in navigating the rafts down the rapids of the great tributaries of the St. Lawrence. Their life in the shanties accustoms them to discipline and to an organized system of working. Their gang-leaders have much of the training of non-commissioned officers, whilst the various descriptions of labour on which men are employed, call forth the energy, the intelligence, and the resource which are invaluable in soldiers. To build huts, to make roads, to bridge streams, to construct rafts, and to navigate them under difficulties, form their yearly work (which by the way they do entirely on tea); whilst the necessity of depending on each other for mutual support and assistance, gives a species of *camaraderie* much resembling that of men serving together in a regiment or a company.

I feel, however, that I am going into details which are beyond the scope of this paper. What I desire to impress on you is, the mutual benefit that would result from a Colonial or Canadian force; for the great Australian colonists appear as yet to be too far removed by time and distance to enable them directly to subsidize our army for European war. They might possibly be able to furnish assistance in other ways, and an Australian fleet in the Pacific, or Australian troops in some

of our important garrisons, would relieve our ships and soldiers from a distant duty and permit of their utilization nearer home. But to revert to my subject. England would benefit directly by the addition of an excellent body of troops to her army, and Canada would derive an advantage similar to that which Sardinia gained by sending her small but well-equipped army to the Crimea, whilst both would profit by the mutual respect and affection which community of danger engenders. From what I know of Canada, and from what I hear from those who are well-informed as to the feelings of the colony, I do not think these views are Utopian, or that their realization would be impossible. That difficulties might arise, and that considerations of expense might have to be duly weighed, I have little doubt; but the end in view would justify some departure from ordinary usages, and would encourage those who might undertake the carrying out of the scheme to more than common exertion. The choice of proper agents is of the utmost importance, and would require some caution, as there are always to be found plenty of men, especially perhaps in the colonies, who are ready to propose and willing to promise anything, whilst the real thorough workers, and people of standing and influence keep in the background. But these are mere incidents common to any new and important enterprise. I have ventured merely to propound the scheme, and leave it to abler men to criticise, to alter, and, in fact, to lick it into shape. My object is to direct attention to the desirability of encouraging our almost grown-up children to assist the mother State, and to the necessity of taking the broader views of the imperial power of England, that our empire—vastly enlarged since the last great war—justifies us in adopting.

It may be objected that in this paper I have mixed up two subjects, and that the employment of a brigade of English volunteers is quite apart from the utilization of a Colonial force; but I would submit that the two schemes have their origin in a similar principle. A European war in which Great Britain might be engaged would probably not be on a small scale. It would be waged with powerful nations, organized so that every able-bodied man might be brought under arms. It would be fought under unknown conditions, as the weapons which science has introduced, especially in regard to naval warfare, make us appreciate David's remark when he gazed on the armour that Saul offered him. It would necessitate the strain of every nerve, the employment of every resource, and the utilization of every advantage.

It has consequently been my endeavour in this paper to indicate two latent forces that have hitherto been allowed to lie dormant. The first, a means of utilizing our middle classes, and of imbuing with an increased element of vitality, the army (for I can term it nothing else) that gives an outlet to their military enthusiasm; the second an idea of bringing into closer union for mutual protection and for mutual support, the great colonies and the mother country. I know that both these schemes have been but roughly sketched, and perhaps ignorantly dealt with; but if the paper I have just read, will lead to thought and criticism, it will not be worthless, neither will the time

you have so kindly accorded me have been thrown away. The subject is one of great importance, and in testing the value of the schemes put forward, no mere professional difficulties, nor desire of preserving intact old bottles at the expense of new wine should be allowed to cloud the broad views of imperial defence that alone can lead to a proper appreciation of all the resources that England possesses for a serious war.

The CHAIRMAN: I beg to invite a discussion on the subject that has been so well and kindly brought before us by Colonel Fletcher. Certainly he has brought forward the general principles in which we should probably all agree, namely, the assistance that England would wish to afford to its Colonies, and the assistance which the Colonies, we hope and believe, would wish to accord to England in any strait in which England might find herself. How to do that is a question of great detail, as Colonel Fletcher has observed; and I hope there are many here who may have thought of the subject, or, if they have not as yet thought of the subject, will think of it, so as to bring that detail into the shape which will make it an efficient plan, because we all agree as to the theory. We all know that military and naval matters are questions of such detail that even the minutest thing down to a cartridge and a soldier's shoe becomes of importance. I have no doubt there are many gentlemen here who will be kind enough to favour this meeting with their opinions. The more the question is discussed, the better will Colonel Fletcher, and the Institution, be pleased.

General MCMURDO: I am sure, Sir, that I share the general feeling of all volunteer officers who have heard to-day the very able, interesting and eloquent paper read by Colonel Fletcher. I confess, personally, that I was drawn here to-day from a desire to see whether that which Colonel Fletcher would say in a lecture, would work out as well as the brigade movements which I had the pleasure of seeing him execute two Saturdays ago, when in command of the Grey Brigade in Hyde Park; movements which were unknown to himself until that morning, and utterly unknown to the volunteers. I allude to the new form of attack, and which he, with a boldness which showed that his heart was in his work and that he had confidence in the volunteers, commenced and executed with perfect quietness and ease on that occasion. I have listened to-day to what he has said in regard to the volunteer force, in the event of war, with a great deal of attention; and while I admit a great deal that he says as to the assistance the volunteers are capable of affording, still, when I come to think of what he proposes, that is, a volunteer brigade, consisting of the cream of the volunteers, going for service abroad, I must, as an old volunteer, fall back upon the first principles of the Force, which have always been defence of our homes and not defiance. I would not have a volunteer force leave these shores under any circumstances whatever. We have a regular army which, if the country is true to itself, and if the country pleases, can be brought up to the proper war establishment. We have next the militia, which, if the country again is true to itself, can be brought up to its proper establishment, and which can supplement the army, not only at home but abroad; but for a system of land and home defence let us have the volunteers, as the *landsturm* of England; and not to leave its shores. If we desire to utilise those volunteers who, as Colonel Fletcher very truly points out, are far a-head of their fellows, who, year by year, attend a greater number of drills, who are born soldiers, in fact, and who are in a great measure dragged back by those who are slower than they are in efficiency; if we desire to utilise them, let us say at once, "Go on, keep up your knowledge; keep up your study of military matters, till the time when England shall require volunteers by the tens of thousands more than what she has got now; you must then be the officers and non-commissioned officers of such volunteers."

It is foreign, perhaps, to the discussion of to-day, and I may be out of order, but I can give it in two words. There is one more thing required for volunteers, and that is equipment. The volunteers are not properly equipped. There is nothing so easy, not for the volunteers alone but for those that support the various corps, as to form committees and take advice from such officers as Colonel Fletcher, who give their

whole heart and influence to the work to get the very best equipment designed to enable the force to take the field.

Commander CYPRIAN BRIDGE, R.N.: Mr. Chairman, I am much obliged to this meeting for enabling me to get up so early in the discussion and make the remarks I wish to make upon the very able and interesting lecture delivered by Colonel Fletcher. I feel it is due to the gentlemen present that I should explain why it is that I, a naval officer, when there are so many eminent military officers present, should attempt to offer any remarks upon a question which is treated from an exclusively military point of view. I do it in three capacities. I do it as a colonist; for I spent several years in a colony, independent of the fact that I have seen in the course of service, on duty, the Colonies from Vancouver's Island in the north-west to Australia in the south-east. I do it also in the capacity of a naval officer who has seen something of a battalion of British volunteers employed in what at least promised to be active service. More than ten years ago I was first lieutenant of a ship which conveyed a battalion of volunteers from St. John's, New Brunswick, where it proceeded to St. Andrew's, close to the American frontier, in order to be ready to repel the attack of a body of Fenians which was openly drilling on the other side of the river; and I was in the same ship when they were conveyed back again. A finer body of men I never saw. Their physique was simply splendid, and their discipline was in all essentials everything that could be desired; and I must say, to see that regiment on parade, clad in the honourable scarlet of the British Line, was a sight which would have done anybody good who cares for manly excellence in any form. This will tend to show that what Colonel Fletcher has proposed is, at all events, on the testimony of an eye-witness, feasible; but there was this peculiarity about the body of which I speak—there was a great distinction, even with colonial ideas of independence, between the social position of the men and the social position of the officers. The men, although physically very fine and well disciplined, and well educated, and of, comparatively speaking, high *morale*, came from a very low class of the population. They were highly paid, and the pay in itself was a sufficient inducement to make them, at a particular season of the year when they were called out, ready to serve. The officers, on the other hand, were men of a rather high social position. Some of them were men of what is not so common in the Colonies as in England—men of independent private means, not dependent upon any profession or pursuit for their livelihood; but many of them also were professional and commercial men. The campaign—if it can be called a campaign—lasted for only a few weeks; but before it had closed, many of the officers, though perhaps none of the men, expressed to me personally their anxiety to return to the places from which they had come, in order that they might be enabled to look after their own interests. That seems to be the great difficulty in employing volunteers from other Colonies, at all events except the great Colony of Canada. Although you might find a sufficient number of men to fill the ranks, it would be extremely difficult to find officers who could spare themselves from their avocations, and whom the country could spare for any length of time. I said just now that the lecturer had treated the subject from an exclusively military point of view. I ought to have modified that by saying that I observe towards the end of his lecture he made one remark which shows he is aware of the necessity of some way or other supplementing the service to which I belong in case of war. He makes use of this expression:—“They might possibly be able to furnish assistance in other ways, and an Australian fleet in the Pacific, or Australian troops in some of our important garrisons, would relieve our ships and soldiers from a distant duty, and permit of their utilisation nearer home.” I wish—and I hope it will not appear to the gentlemen here present that I say so from any reason of mere professional jealousy—I wish that the lecturer, with his high name, not only in his own profession but in literature, a name which I have known for several years, would see fit, in such a lecture as he has read, in some way to allude to what he of course must be well aware of,—the vast nautical resources of this empire and the North-American Colonies in particular. There is Canada with her vast sea-board, and the lower maritime provinces with their vast sea-board, and their, comparatively speaking, immense maritime populations. The nautical habits of the inhabitants there, might supply us with what we most want, an available reserve. Members of this Institution who have been in England during the past year or two,

and have heard papers read here, will be aware, although it is not generally known in the country, that we have practically used up, at this moment, the whole of our available mercantile reserve for the navy, in the 18,000 or 19,000 men who have been nominally enrolled in the Naval Reserve ; and finer men no officer would wish to see. We have used up almost the whole of the seamen of the British mercantile marine. I myself read a paper in the Theatre of this Institution before the National Artillery Association on a kindred subject to that which we have listened to to-day. We might, I believe, raise a volunteer force—a commencement has already taken place in it—to supplement our naval reserve ;—not to make men play at sailors ; but to raise a force in different parts of the empire, not in Great Britain alone, but in the Colonies, and especially in the maritime colonies, who might take the place on the coast and in the harbours, of those seamen, whose seamanlike knowledge would be better employed and be of more use and advantage to the country on the high seas. In reference to the proposal which has been made by Colonel Fletcher to-day, of sending a corps of volunteers abroad,—a proposal which the gallant general who has just spoken traversed,—if it were carried out, I am afraid that Colonel Fletcher would be giving the authority of his high name to what would lead to raising up, in the class from whom the volunteers are drawn, a spirit which would tend to foreign, if not to aggressive, war. It may not be so, but it is a dangerous thing to evoke such a spirit ; and I quite agree with the gallant officer who spoke first, that the proper place for the volunteers is to fight for the protection of their homes. Let us carry that one step further, and have a force of naval volunteers who, as I said before, without attempting to play at sailors, will prevent the necessity of volunteers fighting for their homes by keeping the enemy outside the coast line, whether it be in Great Britain or the Colonies. If such a force as that for our first line of defence was strengthened, I believe the empire will then be able to assume that position which certainly is its proudest one,—to assume an attitude of watchful observation and reserved strength,—that position which I believe it is assuming now ; ready to strike when required, but reserving its force until the necessity arises.

Major-General Sir JAMES E. ALEXANDER : I wish to say a very few words relating to the Canadians. I was fourteen years in America altogether, and was a good deal in the woods there, and became acquainted with the valuable qualities of the timbermen or woodsmen. I entirely agree with what Colonel Fletcher says, that there is an excellent mine from which to derive valuable assistance in Canada. During the Crimean war, when I was about to go to the Crimea, two thousand timbermen volunteered to go with me—men of the most valuable description. They were very healthy and sober, as the Colonel said. What they took was tea, not grog, and they were able for anything. They were skilled in the use of the axe and the rifle, and were exceedingly anxious to serve. I asked them on what conditions they were all willing to serve, and they said, "We want the pay of the British Guards,"—a little more than that of the regular "army—and we are willing to engage first for two years." Very unfortunately these men were not encouraged to go. The proposition was laid before the Secretary of State for War at the time, and he thought he could do without them, so that their services were not required. Then in America, on the Ottawa, and also in New Brunswick (where I was), there is a large number of young men, the sons of old soldiers. These are full of military ardour, and they were most anxious to serve and to smell powder. They are the sons of old men who had talked to them of old battles, and some of them were most anxious to fight ; so that from these people and these young men, there was a large number I am convinced, especially Highlanders, who, if they were encouraged at all by the music of the bagpipes, would be wild to fight. These are the only remarks I wish to make ; but, as I have said, we have the means of recruiting valuable men from our Canadian Colonies.

Colonel T. ALCOCK : Mr. Chairman, You were kind enough to call our attention to general principles, and invited any one to say what he could upon the subject. I do not know whether I shall be able to make myself very clear in trying to express the impression which the excellent lecturer made upon myself, and which I think is different from that which is made upon the distinguished General who alluded principally to the case of volunteer forces for foreign service—offensive instead of defensive employment. The

impression which Colonel Fletcher's lecture made upon myself was one which not only laid down a general principle, but it laid down a general principle which is exceedingly required, and which has never been touched upon before in this hall. On Friday last we had a most animated and interesting debate upon a subject which really was the absolute force of the empire.¹ The absolute force of the empire is of course the armies and the navies always ready for action. To-day we have had a most interesting lecture never before touched upon—the relative power of the people in the empire, which, whether at Home or in the Colonies, consists of the natural means of defence, and of the physical, social and political condition of the people by which the armies and the fleets are manned, the militia and volunteers are the outward expression of that relative power—the sample by which to judge of the material, of which there is an ample abundance in reserve.

As I understand the object of the lecturer, it is to introduce some general principle throughout this great empire, by which that relative power should be organised and instructed throughout, upon the same plan, and to define (by the help of those who are superior to myself in knowledge upon the subject), the manner in which to get it done—to obtain a central and scientific source of information, with a local liberty of action. The progress of science has been referred to. It is self-evident that in these days, when so much depends upon the progress of science, the militia and the rifle volunteers in the Colonies should be kept up by imperial information exactly to the mark at which they are at Home, that the same system should exist throughout. The facility that is now afforded of communication by the electric telegraph makes it evident, of course, that many things are much more easy to be obtained now than they formerly were. Last year, if my memory does not fail me, we heard it said, and we saw it in print, that the militia and the volunteers were not to be depended upon for the defence of their country. That is exactly the reverse of what the real fact is. The whole system throughout the Continent is militia in point of principle. The object being that every man fit for military service should be trained to serve; and the only difference between the Continental system and our own is that theirs is compulsory, and that ours is a voluntary service. The difference between compulsory and voluntary is this, that the compulsory is for aggression or attack, and the voluntary is for defence. That the compulsory drags the unfortunate men from their homes, and sends them forward like animals to the slaughter, whether they have an interest in the cause for which they are compelled to fight or not; but the voluntary principle is for a cause which is well understood—the prosperity of the people and the safety of their homes. And I say that in this great empire that will be the case, and that the principle which Colonel Fletcher has introduced, as I understand it, is one which ought to be taken up, and to which should be given the importance it really deserves, as it affects the direction and organisation and instruction of the relative power of the whole empire upon the same uniform system, and its application and its use throughout upon the same system. We have enormous interests at stake. There are the interests of 290,000,000 people to protect, and we are all in the same interest. It is very true there are people of different tongues and different tribes, but they acknowledge the justice of our rule, and have learned to honour the Queen for the protection they enjoy; but if we are coming to times of trouble, times of trial, and times of danger, we must trust to our confederate strength for the defence of the honour of our empire and the influence of our race. Men of the same speech and of the same spirit will say, "Long may true Anglo-Saxon liberty endure! Long live the Queen of Great Britain and the Isles, Queen of the Dominion and of the Colonial States!" and the princes, chiefs and people of India will be ready to defend against all intruders, the interests of their Empress or Padishah.

The CHAIRMAN: Although it may have been mentioned that the volunteers and militia were not to be trusted with the defence of the country, it was only a slight opinion that was given, and not approved, I think.

Captain J. C. H. COLOMB, R.M.A.: I think we must all feel indebted that this question has been brought before us in the way it has been by the lecturer,

¹ "Russian Development, and our Naval and Military Position in the North Pacific." By Captain J. C. Colomb, R.M.A. For lecture, see page 659, *et seq.*

and I confess to feeling some hesitation in attempting to criticise any paper by the distinguished Historian of the American War; but as he has invited discussion, it may be as well that the discussion should not flag, and therefore, I wish to make one or two observations. Now the lecturer has recognised the fact, that defence must be an imperial thing; but the drift of the paper, as I understand it, is to show the feasibility and the desirability of utilising some portion of our volunteer force as a power of imperial attack. It appears to me that, before we talk of expeditionary forces, we are bound to consider our state of defence; when it becomes necessary for us to send expeditionary forces, the English Empire will be at war. That empire is found in every quarter of the globe, and on every sea. You cannot localise that war. You may be putting your military foot down in one part of the world, while other powers are putting, perhaps, a naval or military foot in other parts of your own dominions; and therefore, before proceeding to enquire into any system with regard to our power of attack, I think, as the volunteer service and the militia force is purely a defensive force, we should examine it by the requirements of our defence. Now the very first thing we shall have to do, is to scatter garrisons over the world. ("No, no.") "No"? I am glad for the correction, I should be delighted if it is not proved to be so. I do not mean to say we must scatter garrisons over the world *indiscriminately*, but there are positions which we must lay hold of and make provision for holding with military force before we can let our only moveable force leave this country for expeditionary service. Your first duty is to see that the vital points of your imperial position are garrisoned. Now, at present, we have only one moveable force. We have three military forces, so to speak, the Regular Army, the Militia, and the Volunteers; every one of these forces has a different orbit of motion. The limits of service of your Army are prescribed only by necessity; the limits of service of your Militia are prescribed by Act of Parliament, within the area of the space enclosed by the waters of the United Kingdom; your Volunteer force is enclosed by St. George's Channel, the German Ocean, and the English Channel. Therefore, when we talk of an expeditionary force, it is evident we have only a very small moveable force to put into the garrisons. Now I will just name some of the garrisons, as it has been disputed. I am only taking an illustration, and I hope it will not be imagined that I am entering into any political question; but I say, supposing we were at war with Russia to-morrow, you could not leave four points on the Pacific Ocean without military force, and, above all things, you could not leave that neglected place, Vancouver's Island, without force. It is a doubtful thing if you could leave such places as St. Helena and Singapore without force; and when you deduct the military force necessary for such places, in order to release your fleet, you have not got much military force left for your expeditionary service. But you have still these two great forces; you have the militia, and you have your volunteers. Now I should rather venture, if I might venture, to differ from some of the views expressed. I think your militia is the first force to consider from which to make additions to your regular army, not the volunteers. I believe, that without any trouble and with very little expense, you can release that militia from its being rooted to the United Kingdom, and so make it available for the garrisons of your fleet bases, and in that way you could release your regular army for expeditionary service of attack. You release your fleets, because they would not have to watch their own arsenals, and you still have your volunteers in their proper place, at home. But now, when you come to enlarge the sphere of the action of your militia, it appears to me you should not only look to your home militia. The sea is the link that binds us together, I will not say the one link, but, practically, the sea is that which, for the sake of the Colonies and the Mother Country, we must guard; and, therefore, I think, in a scheme of imperial defence, the Colonies should certainly assist to maintain the garrisons of those places on which the sea communications depend; and I have some reason for thinking that there should be and can be (not as a theory, but as a matter of fact), a reciprocity system between the obligations of service of your home militia and your colonial militias. I have some reasons for thinking so, judging by the press of Canada, and of many other Colonies; they all complain that we have been so busy about our schemes at home that we have excluded them from all consideration. I have not a doubt that the Englishmen in the Colonies are the same as the Englishmen at home, and that they will shed their

blood, and throw their money broadcast for the defence of that which concerns every Englishman—the defence of the British Empire. Therefore, what I believe is, in dealing with an expeditionary force, the first thing you have to consider is to release your army, to leave it free; not to have it hampered by having to send it as a defensive force to Vancouver's Island, St. Helena, Antigua, or anywhere else; and your proper line of imperial military defence is your militia. There is a clause in the militia engagement, of which everybody is aware, that binds a man to serve "in the United Kingdom, so long as Her Majesty should require his services;" and I believe if you substituted "British Empire" for "United Kingdom" you would not reduce your militia force one man. I am satisfied that if the mother country sets this example, as she should to her younger children, you will not find colonial militias hesitating to reciprocate that obligation by rendering themselves liable for services according to the necessities of imperial defence. Then you have still your line of home defence, the volunteers, and I think, considering the class from which it is drawn, considering the many occupations, and the many ties of those who compose that force, although I quite agree with Colonel Fletcher that if you look at it, not as a matter of imperial necessities, nor of imperial defence, but as a simple process for improving the volunteers; I go so far, but no farther. I do not think it is a plan that would much add to your power of imperial defence, but I think it would be of inestimable value to the volunteers themselves. I would just like to read two extracts from the press of different parts of the world. Here is one from Canada, from the *Volunteer Gazette*, of 2nd February, 1875: "In the event of a great "European war, it will be absolutely necessary for Great Britain to set her house in "order. There can be no new trials. Our position, geographically and strategically, "is such that we can, to a very great extent, compel our neighbours to look to their "home concerns, and to make it their direct interest to take the part of Great Britain "in the quarrel, others keeping open a vital source of supply—food—for her people.

"If this is to be done effectually, British statesmen must be up and about their "business. * * * * Our defensive movements must no longer be confined to "the hedge rows of England."

The next is from New Zealand, 1874. The whole tendency of the article is in favour of what I say. "The defence of the empire may possibly become a popular cry "when it is too late to save many of its most valuable outlying possessions." I hope it will not be too late; and I think Colonel Fletcher has done good service in bringing forward this subject, carrying our minds, as it were, away beyond the shores of England to the homes beyond the seas. He has done a great deal, and I trust will yet do more to make Englishmen, no matter what service they belong to, remember this, that our English homes are not only in these two small islands, but they are scattered over the world.

Colonel LORD ELCHO, M.P.: I would say one or two words on the excellent lecture which has been given by Colonel Fletcher. As a volunteer I should say, first, that I think it a very high compliment paid to the force, of which I have the honour to be a member, that a distinguished officer like Colonel Fletcher should have made it and its capabilities the subject of so admirable a lecture, and that it should have been delivered in this hall to such an audience. Now, the volunteers have gone through many phases of public opinion and public feeling. There was a time when they were over-praised, in the early days of the movement, simply because in, as we thought, a case of national need, a number of public-spirited Englishmen came forward and took upon themselves what, by law, is everybody's duty, namely, military service for home defence. Then, later on, we got the cold shoulder; and one of those who wrote articles against us, told me himself, that the reason he did so was not that he saw a want of discipline and defects which were shown up in these articles and letters; but that he was afraid we were getting too popular, and might be an injury to the army. Well, that phase also passed over; and we have come now to another stage, which is a stage of returning popularity, and which, I think, was greatly increased by the review last year in Hyde Park, of as fine a body of volunteers as, I think any soldier will admit, could be seen; and, I am sure, many of the soldiers now present would wish they had such a body of men under their command, instead of boys from 16 to 20, such as they have now. When they passed before Her Majesty, I think it struck the public as being a very remark-

able and effective display on the part of the volunteer force. But through all this, through good repute and through bad repute, believing that it was desirable in the interests of the country that this force should continue to exist, the volunteers have held together, and are more numerous now, I believe, than they have been at any time since they were established. Not only that; but although we have been told by those who criticise us, that when a pressing time came, and there was a danger of war, the men would not be forthcoming; yet every volunteer will tell you that we have never had so many recruits coming forward to join our regiments as we have at the present time, when there is, it is thought, a chance of their services being required, at any rate for home defence. The spirit, moreover, of the volunteers here present has been shown by the way in which Colonel Fletcher's paper has been received; for, I am bound to say, listening impartially to this discussion, that the objections that have been raised to Colonel Fletcher's proposal have not been received as heartily as were his proposal that the volunteers should be used for foreign service. That is simply a fact, of which any one who has ears can judge for himself. The volunteers, then, may now be well satisfied with their position. We know that we are necessary for home defence; and we have the great fact that Colonel Fletcher, as I have said, has thought us worthy to be the subject of a lecture. I now come to the lecture itself. I am glad to see on my right hand a gallant general, whom I may call the foster-father of the force. I mean General McMurdo. And I can only say that those who had the pleasure of being under his orders—I am almost afraid to say how many years ago—in the year 1859—will say that his popularity is as strong with the old hands at the present time as ever it was; while his popularity has been handed down by tradition to those who since his time have joined the force. General McMurdo is opposed to the proposal of Colonel Fletcher, on the ground that it is contrary to the original constitution and intention of the force. Captain Colomb also takes the same view. Now, I agree with Captain Colomb, and my foster-father here, to a certain, but not to the full extent. I think that before the volunteers go on foreign service, the right thing, as Captain Colomb has pointed out, is to thoroughly organise your military system as it is. Now, I venture to maintain that our military system exists on paper, and on paper only. That system is, 1st, an army for general service everywhere, voluntarily recruited. 2nd. A militia force, compulsorily recruited by law, though the law is always suspended, for home defence; but which has the power, under Acts of Parliament, of volunteering for foreign garrison duty, and which might, if necessary, volunteer also for active service in the field. I know that many militia colonels say that they feel confident that their whole regiment, if invited, would willingly be put on a roster for foreign service if required. Lastly, you have the volunteer force for home defence only; service in which constitutes an exemption from compulsory service in the militia. Well, then, you have thus your militia raised by conscription or the ballot for home defence, and with the power of volunteering, after being so raised, for other purposes. But, as I have said, this law is not enforced; it is annually suspended; and you recruit your army and your regular militia by the same means, viz., voluntary enlistment, by giving every inducement you can to get the men to join. I say, then, this is not putting in force your legal system and power of military organisation, and for the present it is only on paper. So also is your mobilisation scheme. We have heard a good deal about mobilisation. It is on paper, and on paper only. You have formed a certain number of army corps on paper, and the nation is, no doubt, greatly indebted to those officers who have done this, because they have thus prevented that state of chaos which would be otherwise lamentable, if you had not something of the kind even on paper. They have taken a certain number of men, and divided them into corps d'armee and brigades; but these are incomplete; and besides, materiel, transport, and various other things are required, which are in a great measure wanting. Take the militia and volunteers. Not only is the militia greatly below its establishment, but there is not a field gun for the militia, yeomanry, or volunteers, except the few batteries of position which Colonel Darby has organised; and the artillery officers who rule such matters at the War Office, have, with this exception, taken from the yeomanry and volunteers what little field artillery they had. I venture, therefore, to say, that the proposition I have laid down is a true one, namely, that our military organisation at present is on paper, and on paper only. The only force

that is always full is the volunteers. As to the militia; how is it being dealt with? There was a committee appointed at the War Office last year, because the militia were always below their numbers. Their strength ought to be 130,000; but they are always greatly below their establishment; and how has this committee dealt with the difficulty? Why by reporting that the militia should be reduced to 75,000! I venture to think that, instead of that, the militia ought to be kept to its full strength, for it is the backbone of our military system, the army. And then this committee has further reported that the militia should be used, not as an integral force in itself, but mainly as a means of passing men through the militia into the army, irrespective of the militia reserve. I submit that that is a departure from the intention of those who originally established the militia; who intended it to be a strong integral force in itself for the defence of these islands.

Now, I say, when you have got your organisation complete, your army thoroughly manned, and your reserves all in good working order; when you have got your paper constitution and your military system and administration put in active operation, and in all things complete; when you have got your volunteers also fully organised and properly trained, it might be a consideration whether they should not be invited to volunteer for foreign service. But, depend upon it, there will be no good done; this nation will never attain its proper strength and position until you make your military foundations secure. What Colonel Fletcher proposes is something which General McMurdo and others would deem, and so far I agree with them, an excellent thing for the force, as showing what the true spirit of the volunteers and the nation is. But you must not look to this as a material element of national strength for aggressive purposes. You must find that elsewhere, and I should be sorry that Colonel Fletcher's lecture should act as a herring across the path of real army administration and proper organisation, which I hold to be in another direction. As regards the Colonies, anybody who looks at that map on the wall will see on the left hand corner two little red spots, which you almost require a glass to find out, those spots represent Great Britain and Ireland; and if you cast your eyes to the right, you will see a red line which contains what they call the Great Powers—France, Germany, Austria, plus Italy, Spain, and Turkey, although I do not call Turkey a great power; but which last is said to have been received into the family of nations, whether she has been kindly treated by the family or not I will not enter into here. Well, you will observe how small a comparative space on the map all these powers occupy. On the other hand, all beyond this, on the other side of the green line, represent the Russian Empire, which has one arm outstretched, and all beyond there is a green line which rests on the Baltic Sea on the right, while its left arm touches the Pacific. While one foot of the Colossus is on the plains of Asia, at the base of the Himalayas, the other, at the present moment, on the Danube. How soon it will be on the Dardanelles or Mediterranean no one can foretell. Looking, then, at the balance of power, which is merely the police of nations, so that one nation should never be allowed to be so strong as to over-ride, and bully, and tyrannise over other nations, what I feel about my nation is that our little island, and the rest of Europe may some day be swamped and overhauled by Russia; but if you look further, on a still larger map, you will see enormous red blotches in the South Pacific—New Zealand and Australia, the Cape—and if those blotches were to be made confluent, as it were, by some such plan as Colonel Fletcher has proposed, you would add immensely to the strength of the whole empire. I think one great value of Colonel Fletcher's lecture is, that it will make Englishmen think, as we have seen by the quotations from Captain Colomb's book, that the Colonies are already thinking and writing in favour of establishing that inter-communication and that solidarity in military matters between England and our Colonies, which, I maintain, are not only necessary and desirable for the endurance and safety of our country, but likewise desirable in the interests of the world.

Mr. STRANGWAYS, Ex-Premier, New South Wales: I have had some experience in connection with volunteer matters in South Australia, and I desire to call attention to one or two points in connection with this question, which, I think, are not sufficiently considered by officers whose experience has been chiefly in this country. The first point is, in the Australian Colonies every man is busily engaged from morning to night. You have not in the Australian Colonies, as in England, a large class of wealthy persons

who are not engaged in business of any kind whatever; and I think I am not going too far when I say that a great deal of the success of the volunteer movement in this country has been owing to the great interest that has been taken in it by the wealthy portion of the community, and the munificent manner in which a very large number of them have contributed to the cost of it. Now in the Colonies you have not that class, and one of the great difficulties in connection with the volunteer movement in the Australian Colonies has been to obtain a sufficient number of men who were in a position to give up their time—and giving up their time means giving up their money—to learn the necessary amount of drill. As to the individual men themselves, they are just as good as Englishmen in any other part of the world. The men themselves are perfectly good; but you have not, in the Australian Colonies and in most of the other Colonies, those class distinctions which have tended in this country to make the volunteer force as successful as it has been. Captain Colomb suggested that England should set a good example to the Colonies in respect to the question of defence. That merely brings up a great imperial question which we must not discuss at this time, or in this place, and therefore I will not allude to it.

The CHAIRMAN: There is no harm in alluding to an imperial question that I am aware of. At least, if I remember rightly, there were some questions in the Friday's discussion that came a little bordering on politics; but certainly an imperial question can be discussed here with freedom.

Mr. STRANGWAYS: I did not wish in any way to trespass on the rules of this Institution, and I adopt the advice given by the Chairman. I will mention an important point which must be considered, and it follows upon the remark of Captain Colomb that England should set a good example to her Colonies. I say that England must do more than that, and that England must follow the example that every wise father adopts when he asks his grown up sons to join in business and work with him; that is, take them into his councils and let them all work and co-operate with him. That is the only imperial point I wish to allude to; and I am sure if I went further I should trespass upon the rules. I say it is extremely gratifying to find, not only one gentleman on one subject, but another gentleman on another subject, all coming back to that same question, combined action between England and the other portions of her Empire, and, I believe, if that question is discussed and considered as fully as it can be, that a satisfactory arrangement can be arrived at. Again, returning to the volunteer force, I do not venture to express an opinion as to whether the volunteer force of this country can readily be made available for warlike purposes; but I would remind this meeting that when the Americans commenced their civil war some 16 years ago they had scarcely any soldiers at all. They had a few militia, and but little more; yet, in a comparatively short space of time, out of some of the rawest and roughest materials it was possible for any people to operate upon, they managed to make—I believe I am correct in saying—one of the finest armies in the world: and surely, if the Americans can do it, we can do it in this country just as well. I believe, further, in respect to the Colonial part of the question, the utmost that can be expected from the Colonies is that they will provide, if not entirely, at all events to a considerable extent, for their own local defence. When you remember that some of the Australian Colonies at the present time are spending (taken together) about a quarter of a million a-year in order to bring Englishmen out into the country, it is hardly to be expected that as soon as they get them out there they would ship them back again. The Australian Colonies are carrying on emigration from this country largely at the present time. I have had the idea that a great deal might be done, and done usefully, if the system of the local defence of the Colonies was worked in connection with emigration, and that if such preliminary matters could be got over as I alluded to just now, and the Colonies could be induced to co-operate with England; then a portion of the Imperial army might be sent out every year and stationed in the Colonies, and knowing they would receive their discharge there, they would become useful emigrants, having drill and discipline they would become good Colonists, and you would have in process of time a very large number of well trained men who would be readily available for any defensive purposes. I merely throw that out as a suggestion. I superintended the emigration department of South Australia for some years, and I know what can be done in that as well as other things. "Where there's a will there's

a way." I desire to express my gratification in finding that so many gentlemen, not only those who have read the papers but so many others, who have introduced the subject to the Institution, do see the real importance of the great question of the Unity of the British Empire, and that they are (though from various points of view) directing so much public attention to it.

Mr. FREDERICK YOUNG, Hon. Secretary Royal Colonial Institute: I should like to be permitted to make one or two remarks before the discussion closes. I have listened, as well as I am sure every one here present must have done, with the greatest possible interest to the very able paper that Colonel Fletcher has read to us to-day. I can only corroborate what Mr. Strangways has said, that I think it is of great importance that questions such as these have been brought forward at this Institution, having for their object the unity of this great empire. It seems to me that the paper has somewhat delicately touched upon a very large question indeed, and that we might follow it up with some benefit, to see whether we ought not to extend our imperial army and our imperial navy to the Colonial portion of the empire. For my own part, I cannot conceive any reason why, considering the number of people that are continually going from this country to the Colonies, we should not feel that we may recruit both our army and our navy, provided they are to be imperial ones, from the outlying portions of the empire, which are just as much interested, as we are at home, in having their homes protected, in the same way that we are ourselves. There is one particular point with which I was very much struck in Colonel Fletcher's paper, namely, the allusion to Canada, and the possibility, in case of war, of any Canadian force being used and incorporated in this country, that it should be organised entirely in the Colony, and under native officers. I know very well, and I have heard some distinguished officers connected with the Canadian volunteer force complain very much indeed, that under the present system their claims are neglected in that respect. I do think that it would be of the very greatest importance for us to recollect that there ought to be but one army and one navy, and that there should be no distinction whatever—provided men are qualified to take high commands—between a Colonial military man and an English military man. I beg to apologise for making these few crude remarks at this late period of the discussion. I am not a naval nor a military man, but I take a deep interest—as every Englishman should do—in these great services; and I hope and trust, from such discussions as we are having to-day, that we may all feel the importance of having, whether it is by volunteers or by some other mode, one great imperial army and one great imperial navy for the whole empire.

Lieutenant-Colonel CHILDERS, R.A.: It would seem to have been forgotten in the course of this argument that the lecturer said the use of volunteers out of England would give a great opening for the employment in war of the middle classes of English society. I think there can be no doubt that every soldier in this room must feel it most important that the military feeling which is inherent in the middle classes of Englishmen should be given an opening of this description. We know very well that our regular army and our militia are enlisted from what we may call the lower classes; and I do not think there is the slightest fear that if the middle classes are employed in this way on foreign service they will in any way, as suggested by one speaker, imbibe a desire for aggression and for the conquering of other nations. I suppose there is no nation in the world which has carried on so many aggressive wars as England has, and all those wars were just wars and wars of which we are proud. Our foreign empire in India and other parts of the world shows that those wars were carried on with a right principle, and from a military feeling, not of unjust aggression but of our determination to assert our rights and to hold what we had got. I am very sorry no better qualified artillery officer has spoken, and the only reason why I have stood up was to say this, that volunteers are most admirably fitted for garrison artillery, but the very great difficulties which interfere with the organisation and maintenance of a volunteer force of field artillery are patent to everybody; and if it be true that any artillery officers in an official position have thrown cold water upon the proposals for the formation of volunteer field batteries, they have done so, we may be sure, on purely professional grounds, and not from any reasons suggested by an unworthy jealousy of a sister service.

Captain A. ABERCROMBIE JOPP, R.E. I rise with great hesitation to follow up to a certain extent the unpopular side of the question, and to support in some degree what Mr. Strangways has said with reference to the practical difficulty of the Australian Colonies (to which so small allusion was made in the paper) of entering into the scheme of joint imperial defence in the form thrown out by Colonel Fletcher. There can be no doubt, taking the question as an imperial one, that the Australian Colonies, in point of imperial defence, must hold a very high share. Regarding the matter from a naval point of view, the port of Sydney, in the South Pacific, is perhaps the most important point we can name; and to defend that port and the neighbouring ports and shores, the great practical difficulty which must be met by the Government, is the question of the proportion of population available for the points to be defended. There is first of all the difficulty pointed out by Mr. Strangways of finding volunteers in a country where every man is a busy man, and where there is so small a proportion of men of independent means and idle time. But in addition to that there is another point, I think, not always considered in regard to the Australian Colonies. We are apt to estimate them by the accounts we see in the papers regarding them respecting their revenue, and we forget the small number of men per area of population who contribute to that revenue. Now, in the Colony of New South Wales (which, although an imperial officer, I happen to be serving at the present time),—and I think I may fairly say that the analogy which I wish to draw applies also to the other Australian Colonies,—the area is 300,000 square miles, about equal to the area of this country and France, or to the area of Germany and Italy, and it is occupied by a population of 600,000—a population equal to about that of Liverpool or Glasgow. The coast line is 800 miles; and if you can imagine the whole of the population of Liverpool or Glasgow first of all distributed over an area equal to the United Kingdom and France, and then called upon to form some organisation capable of defending a coast line of 800 miles, I think you will find that their work is pretty well cut out for them, without their being asked in any way to relieve our troops elsewhere, as was, I think, suggested by Colonel Fletcher, although not in a definite form. The Australian Colonies would, I perfectly believe, accept the imperial principle that a share of colonial defences is to be undertaken by the Colonies; but I think we ought not to ask them to do more than their fair share. We have, out of the population of 600,000 in New South Wales, 5,000 well-equipped volunteers: they have small bore rifles, which is more than we can say for all our volunteers elsewhere; and as far as equipment is concerned, I can assure General McMurdo that, considering they are on the other side of the world and the difficulties which equipment naturally presents, they may favourably compare in that respect with our friends nearer home. But they cannot be expected to go beyond a certain point. If you have 5,000 men, out of a population of 600,000, acting as volunteers, you will admit that, if that population is widely distributed, 5,000 is a fair, although perhaps not a sufficient proportion.¹ You must remember also, that these volunteers are the whole body, except one permanent battery of artillery raised in the Colony, and that they are not auxiliary in the sense in which our volunteers are auxiliary; and in that respect you ask a great deal more from them than you do in this country, because in Australia they are not, under existing arrangements, an auxiliary force, but they are the only force available for land defence. They are willing to do their share; but I venture humbly to protest against their being asked to do more.

The CHAIRMAN. I wish to remark for myself, with regard to the system of volunteers, that I hope we of the army shall always consider them as brethren in arms who are united with us for the defence, not only of this country but of the empire, if necessary. Whether they will be enabled by an organisation that the

¹ The population is not equally distributed over the large area quoted, but predominates in or near Sydney and the larger towns; and the vital points on the coast line are not numerous. On this account the analogy must be admitted to be imperfect; but the argument is submitted as fairly illustrating the difficulties to be met in organising a volunteer force in a small and scattered population.—A. A. J.

army has not fairly yet, namely, the organisation of the civil departments of the army which are so necessary, and which must be extended to the volunteers and to the militia in case of war whether they would be able to take their part abroad, or not, is a question which we hope may be put off for some time; but we may also feel this, that we may depend upon the militia and the volunteers for taking their full share when called upon; and if ever they are called upon I hope it will be by regiments instead of giving recruits to the army, for I think it maintains the strong regimental and local feeling that they should volunteer *en masse*, as a battalion or a regiment, to assist, as they did assist during the Crimean war, either in garrison, or, if necessary, in the more active service in the field. They would feel that *camaraderie*, which is so valuable, and go back to their county or town with the same sort of regimental feeling which, I hope, will always be kept up in the army itself.

Colonel FLETCHER. I find it somewhat difficult to arrange my notes so as to reply in detail to the many valuable remarks that have been made, and I think it may be the best plan to take them *seriatim*, as although, possibly, I may mix up the subjects, I shall yet be more distinct in meeting the objections or criticisms of particular individuals. In the first place, I thank General McMurdo very much for his kind observations in respect to the practical as well as the theoretical part I have taken with regard to volunteers, and at the same time say that I quite agree with him that the motto of the volunteers should be, "Defence, not Defiance"; but I submit that England has never yet waged a purely defensive war. We cannot afford to let the enemy land in England: we must fight abroad. If we want to defend London, we should probably fight in Belgium: if we require to defend India, we should probably have to fight to maintain the communications with India. I do not in the least wish to advocate defiance, because, happily, we are not an aggressive nation; but I want to point out that, in the event of war being necessary, we ought to give an outlet to the military enthusiasm of the middle classes at the commencement of that war. I may at the same time say that Colonel Alcock, as far as I gather from him, quite agrees with me, and I would sum up my argument by urging that if we do not use the whole of our population for war, and for war beyond the sea (as we must not wait until it actually touches England), we shall fight with one of our hands tied. That is the line I have taken.

With regard to what Lord Elcho said, I fully and entirely agree with him. My plan is merely a small one compared with what he advocates; and I should be sorry if any petty scheme of mine should divert people's minds from the great importance of organising the whole of our forces.

In reply to Captain Colomb, if I have proposed nothing in regard to adding to the defensive strength of the empire, except to improve the volunteers by raising their morale I submit that I shall have added greatly to its armed strength.

With regard to the observations of Captain Bridge, I would say that the reason I did not allude to naval matters is because I understand so little about them. I should like very much to see the whole naval subject taken up by somebody, and a lecture given here on the maritime resources of our Colonies, to show what New Brunswick and the inland lakes of Canada could do to contribute to our naval strength, and I throw out this hint in the hopes that somebody may act upon it.

With regard to the difficulty of procuring officers: having lately come from Canada, I know there are a great many Canadians anxious and willing to serve, who have devoted their time exclusively to military matters. There are two Schools of Gunnery, one at Kingston and the other at Quebec, also a force embodied at the Red River, where the officers are simply military officers in every sense of the word.

In answer to Captain Abercrombie Jopp, I alluded but shortly to the Australian Colonies, because I do not know much about them, and for another reason, which he answered himself, namely, the small proportion of the population to the extent of the area they cover, and to the consequent inability to provide for any force beyond their own shores. With regard to one of his objections, that they could not do anything but defend these shores, I must quote from Captain Colomb, who, in an able lecture delivered at the Colonial Institute, showed that the protection of Australia and of some of the Colonies of the Pacific, was not actually in those Colonies, but at certain well-known strategic points, which would require garrisons to be furnished by these Colonies. With regard to what fell from Mr. Strangways, the

ex-premier for New South Wales, I can only say that I am very glad he made the remarks he did. I did not allude to the political question excepting indirectly in pointing out that we should not deal with Canada merely as a recruiting ground, but should take the force it is proposed to raise, with its officers and with its organisation, and so treat Canada as an equal. In this way we would raise the spirit of the colonies, whilst we should show them that we are prepared to deal with them in a broad and proper manner in other matters besides purely military ones. Of course, to return to the first portion of my paper, if we cannot get men, *cadet questio*, the whole plan falls to the ground; but I have been assured by a great many officers, who know the volunteers well, that if you only held up your finger you would get a large number of good men to volunteer for service abroad, and that you really might raise an excellent force, valuable not only for actual numbers, but as the yeast which would leaven the whole lump. I will conclude by thanking General Alexander for his remarks about the 2,000 lumbermen who volunteered to accompany him to the Crimea; and I hope the next time they offer to do so, they will be encouraged, and not discouraged. I think these are the only remarks I have to make, and I can only thank you for your kindness in listening to my lecture.

the
y in
nd,
ts
rit
em
Of
tio,
ers,
t a
ght
ich
for
the
nd
nly

LECTURE.

Friday, May 25, 1877.

MAJOR-GENERAL T. B. COLLINSON, R.E., in the Chair.

RUSSIAN DEVELOPMENT AND OUR NAVAL AND MILITARY POSITION IN THE NORTH PACIFIC.

By Captain J. C. R. COLOMB, R.M.A.

WHEN invited by the Council to read a paper on this subject I was much perplexed. It is an honour to stand here by invitation, but it is rather uncomfortable to feel that while the question to be considered is very large, one's own special information is very incomplete. Had I followed my own inclination I should not now be addressing you, but having had some difficulty in collecting the very scanty information I am about to offer this Institution, it appeared only right to save others the trouble I myself have experienced in collecting it. I therefore felt it my duty to accept the invitation: hence the reason I stand here now to give a very meagre outline of "Russian development and "our Naval and Military position in the North Pacific."

To those who wish to study matters relating to Russian acquisitions on the Pacific, I would point out that "Ravenstein's Russians on "the Amoor"¹ will be found an invaluable work. Having derived so much valuable information from that book, I wish to draw the attention of others to its value and to say a considerable portion of the historical part of this paper is derived from that source.

I shall divide my subject under two heads, "Historical" and "General," and then offer some very brief remarks which may possibly suggest useful topics for discussion, and perhaps very serious thoughts.

"Historical." 1514—1847.

In 1513, while Henry VIII was invading France, while Albuquerque was extending Portuguese power on Indian seas by capturing places of strategical importance, Spain was pushing her power with military forces beyond the limits of the waters of the Western Atlantic.

¹ Published by Trübner.

Between the Portuguese naval hero at Malacca and the Spanish military chieftain forcing his way across the Isthmus of Panama lay an El Dorado of two great empires of the sea—a new ocean. Both these came from countries small in territorial area, and adjoining each other, both thirsted for the conquest and consolidation of dominions beyond the seas, and each sought their goal in directions exactly opposite, and by means widely different. The one represented naval power: the other military force.

The goal was first reached by the representative of military force, Vasco Nunez de Balboa, who, stepping into the waters of the unknown sea, "claimed it and all it might contain"¹ on behalf of the crown of Castile. The Russians were already at the foot of the Ural Mountains, and rapidly spreading eastwards towards that same unknown sea which Magellan—on entering in 1521—rightly or wrongly named the Pacific Ocean.

Later—1587—while the King of Spain was preparing to invade England, the Russians were still advancing eastward and, before Howard, Hawkins, and Drake had showed him that neither was his Great Armada invincible nor all the seas his own, they were laying the foundations of Tobolsk.

In 1632 they founded Yakutsk, and four years later heard vague reports of the great Amoor. Advancing still eastward but to the north of the 60th parallel they established (1638) their first settlement, Okhotsk, on the shore of that ocean, which Nunez had claimed for Spain, about the time Mr. Pett, naval constructor of the English Admiralty, was congratulating himself on having successfully launched the "Sovereign of the Seas"² carrying "murdering pieces" and reputed to be the "most magnificent ship in the world."

Yakutsk appears to have been then the Russian head-quarters of that remote region lying far away to the north of the Amoor, which was rapidly overrun. In 1643, the year the Dutch discovered Fiji, Poyarkof, with a small party, left this place on an exploring expedition. He struck the Dzeya, and following its course downwards, came to the Amoor. Overcoming all difficulty and some opposition, he finally reached its mouth. From thence he proceeded by boat along the coast as far as the Ulya River, a little to the south of Okhotsk, and striking across country safely reached Yakutsk in 1646. Soon after, another expedition, under Khabarov, was dispatched to explore the Amoor; failing to reach its mouth it re-ascended the river. The advanced portion of reinforcements, dispatched from Yakutsk in 1551 to his assistance, missed him on the river, and, like Poyarkof's expedition, reached its mouth, proceeding from thence to Okhotsk. Meantime a force had been dispatched from Moscow—ultimately commanded by Stepanov—to occupy the newly discovered region of the Amoor. This expedition wintered at the mouth of the Kamara, 1654. In the ensuing spring it was besieged for three weeks by 10,000 Chinese troops, which it beat off and finally established itself in a strong position on the north bank of the Amoor, some 200 miles from its

¹ "Conquest of Peru." Prescott.

² Derrick's "Memoirs of the Royal Navy."

mouth, but only 80 miles from the sea. Here it wintered. The end of this expedition was disastrous. Stepanof was attacked by a Manchu flotilla just below the Sungari, and lost not only his own life, but—with the exception of forty-seven followers—the whole of his force. It appears a large number were either taken or voluntarily went to Pekin, and thus was created the connection with the Celestial capital, which among other things led to the establishment of a Russian college and church in that city, which has continued down to our time.

While Stepanof was exploring the lower Amoor, Pashkof—who was then Commander-in-Chief of Russian forces on the Amoor, with his head-quarters at Yeniseisk—had occupied the Shilka. Thus it happened that in 1661, the Russians had been driven from the lower Amoor, while Pashkof, having provided for the permanent occupation of the Shilka, by founding the now celebrated town of Nerchinsk, was on his way back to his head-quarters at Yeniseisk—at the time the country of Albuquerque ceded Bombay to England.

It does not appear that any further attempt was made on the lower Amoor till 1663, when a post was established at Albazin—between the Dzeya and the Shilka. With this point as a base, many other ports and settlements were established on the northern territories of the Amoor. In 1683, however, a Chinese army destroyed the whole of these posts and settlements and only Albazin remained.

In 1685, a Manchu force, 18,000 strong, ascended the Amoor in 100 large boats with 15 guns (from 5 to 8 pounders) and laid regular siege to Albazin. The total garrison consisted of some 450 men of all sorts and conditions—commanded by one Tolbusin—and having only at its disposal 300 muskets and three small guns. Re-inforcements, however, were at the time on their way from Yeniseisk. In the first few days of the siege the garrison lost nearly one-fourth of its entire force. Tolbusin capitulated, and the garrison was generously permitted to march out with their arms. A few days' journey from Albazin the anxiously expected reinforcements were met—but the whole force retreated to Nerchinsk. Albazin was, however, almost immediately re-occupied and held till 7th July, 1686, when a Chinese army with some 3,000 horse and 40 guns suddenly appeared surrounding it. The garrison mustered some 700 men, with 8 guns, 1 mortar, 30 shells, and 400 hand grenades. On the 1st September, the Chinese attempted to carry the place by assault, but were vigorously repulsed. Tolbusin soon after was killed, and by the 1st November, what with losses in action, privation and scurvy, the garrison was reduced to 115 men. Though the Chinese offered honourable terms this loyal little band refused to surrender, and soon after other causes, not military, led to the raising of the siege. A sort of armed armistice was established till in 1689, when the treaty of Nerchinsk was signed, which, while it left the Russians the Shilka, deprived them of all territories or settlements to the south of the Amoor lying eastward of the point at which the Shilka joins it. It also defined a boundary to the north of the Amoor, which struck the Sea of Okhotsk some 2° north of its mouth. It, in short, secured to the Chinese not only the whole

seaboard up to that point, but it also kept the Russian land boundaries far away to the north of even the sources of all tributaries flowing into the Amoor from the north. In this year while the Chinese were thus rolling back the power of Russia away from its seaboard, the first English factory was being established at Amoy. The following year Kamtschatka was discovered by a Cossack chief, Morosco. It was taken possession of by Russia in 1697; and in 1728 two ships were built there to furnish means for a Russian exploring expedition under Behring, which ultimately led to the discovery of Alaska—forming the north-western portion of the continent of America, and of which Russia took possession.

Passing over all events, however instructive, which are not germane to the object of this paper, the next point of interest is the rough survey of the coast lying immediately to the south of the Amoor, made by the French nearly one hundred years after the Treaty of Nerchinsk. Cape Suffrien and Castries Bay not only perpetuated the remembrance of that visit, but these names also recall the deeds of a great Admiral and a great naval administrator of France, who but for the genius of Rodney and the dogged perseverance of Sir Edward Hughes, would have shaken our empire to its foundations, and swept us from western waters and from eastern seas. These names remind us of the very gloomiest period of our history, a study of which should be to us a warning for all time.

The next approach to the shores of the Gulf of Tartary was made by Russia *via* Japan, 1803-5; being diplomatic and not military, and withal a failure, it need not further be noticed. It is worthy of remark, however, that while Napoleon at Boulogne was preparing for the invasion of England, the Russian Admiral Krusenstein—in command of the Russian squadron at Japan—was preparing to occupy Aniva Bay, at the south extremity of Sakalin, which island forms a sort of natural outwork to the Amoor coast; while Kornilof, the Governor of Irkutsk, was suggesting the construction of a gunboat flotilla far inland, with which to force open the navigation of the Amoor, and thus to join forces with Krusenstein. The year Nelson died the Russian standard was hoisted at Aniva Bay, and formal possession taken. This step, however, was retraced in accordance with orders from the Russian Government, which had already a mission at Pekin.

Nothing of naval or military importance occurred in these regions until General Muravief was, in 1847, just thirty years ago, appointed Governor-General of Eastern Siberia. Having now in a few words covered the history of three centuries, it may be as well to pause for a moment at the year 1847, to consider the then relative positions and development of the sources of war strength in the North Pacific, so far as concerns the object of this paper.

Starting from the Equator, we have, first, at the western limits, the Philippine Islands, with an area of 65,000 square miles. They are the last relics, so to speak, of the fallen naval power of Spain. Following to the northward, we come to a small island, but 29 square miles in extent—Hong Kong—a solitary unarmed sentinel over British

interests and British honour in the western half of the North Pacific Ocean. From this point, for some 33° of latitude, the whole coast line was then, 1847, Chinese territory. Further out in the ocean, with its area of some 150,000 square miles, lies that then sealed book, Japan, and, immediately to the north, Sakhalin, the northern half of which then belonged to China and the southern half to Japan. Its computed area is some 30,000 square miles. Thus, on the Asiatic or western side, the Russian seaboard was wedged in between the Chinese and the regions of eternal ice, without any water communications through her maritime provinces, and possessing but one port worthy of note—Petropaulovski in Kamtschatka, closed by nature during some months in the year.

Crossing the North Pacific by Nature's stepping-stones, the Aleutian Islands, we find ourselves still in her territory, and, following the coast line, and passing by Sitka, its chief port, and then but a lonely trading post, we leave her dominions about 55° N., and are again on British soil. Vancouver's Island, with its area of 14,000 square miles, had only four years before this period been, for the first time, "traversed by white men,"¹ and was in 1847 being made over by the Crown to the Hudson's Bay Company. Of this portion of the British Empire, Captain Mayne, writing ten years later (1857), as "little known and still less less heeded."² Still pressing our way southward, and crossing the Channel, we are in the United States. This coast then was a desolate region, uncared for and unknown. A wanderer in this year would have seen a solitary untempered mortehouse close to where Sacramento City now stands, and perchance a workman, one James Marshall, busy erecting a wooden saw-mill, and on the eve of catching sight of those glittering specks in the mill race, the discovery of which was so soon to revolutionize the western world. Passing from California into Mexico, we arrive ultimately in a wilderness of small states emerging from the ruins of the military power of Spain. To sum up the "bird's-eye view" of the North Pacific, when Muravief was appointed Governor-General of Eastern Siberia in 1847, the sources of Russian maritime strength lay between about the 55th parallel and the Pole; and, turning our eyes southward, we behold on the western side the last vestige of the former naval power of Spain, and on the eastern the ruins of her great military achievements. We saw, at starting, the great unknown ocean spread out, as it were, between the representatives of naval power and military force; and now close this brief historical sketch down to 1847 by pointing to the decline of both.

1847—1877.

One of the first acts of Muravief was to send an expedition down the Amoor, which was never heard of again. He next caused the coast to be surveyed, while measures were taken at St. Petersburg to strengthen the Pacific fleet. By 1851, not only had the Amoor been entered, but trading ports were established at Nicolayevsk and at

¹ "Vancouver's Island." Macfie.

² "British Columbia, &c." Captain Mayne, R.N.

Mariinsk, just opposite to which Stepanof had wintered two hundred years before. Mariinsk was a point of strategic value, owing to the fact that it was but fifty miles from Castries Bay, with which there was "water communication seven feet deep to within twelve miles."¹ Castries Bay is one of the best harbours near the mouth of the Amoor.

It is possible some here may be able to recall, even after the lapse of twenty-four years, a little circumstance which occurred at Portsmouth in 1853. A small Russian squadron—two frigates and the small steamer "Vostok" built in England—put to sea from Spithead. Through some mistake, its parting salute was not returned by the garrison, till it was somewhere at the back of the Isle of Wight. This neglect gave rise to some comment in the press, while the destination of that squadron was too far off to attract attention, it was going to that unheard-of place, the Amoor! The Commander² was destined, by a judicious combination of naval power and military force with a fixed and fortified base of operations, to protect his own territory and his own fleet against a naval combination of France and England; he was also on his way to accomplish that which for two centuries had been the desire of all the Russians, viz., to bring the Russian seaboard down to a temperate climate, and to open up water communication with the interior. That same year, 1853, a trading port was established at Castries Bay, and as coal had been discovered at Dui on Sakhalin, just opposite, a force was stationed there for its protection. This year closed with the eyes of Europe fixed on the Danube, and with a Russian man-of-war ("Vostok") for the first time wintering in the waters of the much coveted Amoor. We, of this Institution, who have nothing to say to politics, must, I think, generously admire a strategy which was not confined to protecting home dockyards on the Black Sea and Baltic even in the hour of their extremest peril, but which, overleaping alike the desolations of Siberia and a clamour for "home defence," was calmly laying the foundations for future naval power at the other side of the world.

The position of the Russian forces here, at the beginning of 1854, is instructive. At the commencement of this brief history I drew attention to the naval power of Portugal being separated from the military force of Spain by the unknown ocean, and in the spring of 1854 200,000 square miles of an unknown region lay between the most advanced military post of Russia and her Pacific fleet. We had both in Chinese waters and in the Pacific fleets superior to hers. The head-quarters of our Chinese squadron was supposed to be at Hong Kong, while the base of the Pacific naval force shifted with the Admiral's flag-ship. On the eve of a great war our Admiralty was working hard in one direction, our War Office in another, the War Minister having no control whatever over the fleet,³ and the Admiralty in no way subject to the supervision or direction of the War Minister.⁴ Thus the English army and the English fleet were in the

¹ "Voyage down the Amoor." Collins.

² Admiral Putiatin.

³ See Question and Answer No. 14,765 } Select Committee on Army before

⁴ " " " " No. 21,034 } Sebastopol.

matter of administration separated by an undiscovered region of responsibility—a veritable *El Dorado* for aspiring writers to the *Times*.

Muravieff seems, however, to have been keenly alive to the fact that a just and close combination of the two is the true source of strength. Already at Petrovsk, situated on the southern slope of the mountains lying between the Ouda and the Khilok, steam-engines and machinery were being constructed and brought to Shilka. By the 28th of May he had not only built a little steamer—the “Aigun”—and a flotilla, but was actually on his way down the Amoor, towing barges and rafts, carrying 1,000 men, several guns, and provisions and stores for the fleet. As his force passed down, dismayed Chinese garrisons, having some faith in treaties, turned out and stood to their matchlocks, or poles blackened at the top to represent lances; astonished Manchu gunners stood to guns mounted on curiously clumsy red carriages, but Muravieff was neither to be intimidated nor stopped, and on the 27th of June he reached Mariinsk, and a few days later was holding consultation with the Russian Admiral on board the “Pallas” at Port Imperial. He appears to have returned to Irkutsk by Ayan, just as Poyarkof had done two hundred years previously.

The detailed movements and the tactical operations of the Russian, French, and English squadrons and ships during 1854–5, I shall not here enter upon. I am engaged in studying this portion of a very interesting and most instructive subject. I shall be deeply grateful for any information officers who served either in China or the Pacific in 1854–5 may think proper to give me. I have some Russian and other accounts, and the French Minister of Marine has kindly furnished me with what information I required, but I must frankly say, while the subject is one from which many lessons are to be learned, it is difficult to handle. In the absence of further English information and more careful study, it would be unwise to enter upon details. The account of naval operations in Ravenstein, while accurate in the main, is very defective in many respects, and should only be read by the light of searching investigation and careful comparison with either personal experience or dates, facts, and circumstances only obtainable by patient labour, and not mentioned in that otherwise invaluable book.

The pith of the whole history of this region, between the date of the meeting of the Russian Admiral and General at Port Imperial and the close of the war, is as follows:—

A few days later the allied squadron in the South-East Pacific received notice of the declaration of war and orders *via* Panama. It crossed the globe to the North-West Pacific to find at Petropaulovski¹ every preparation made for its reception. A certain portion of the Russian Pacific fleet, aided by military forces, drawn, as we have seen, from a point 2,200 miles from the sea, and 3,000 from Petropaulovski, occupied a strong position. The result was disaster to the allied

¹ Beechey, writing in 1827, says:—“Should the North Pacific ever be the scene of active naval operations, Petropaulovski must doubtless become of immense importance. At present it may be said to be unfortified, but a very few guns judiciously placed would effectually protect its entrance.”

arms, and ten days after the fleets had first appeared off the place they were returning whence they came. The next year a stronger force having again crossed the globe arrived off the same place only to find it evacuated. The Russian forces retired from Petropaulovski via Castries Bay and Mariinsk, fixing a firm grasp on the lower Amoor. They did so under the guns of the combined fleets of France and England. This is in brief the whole story of two years' naval campaign in the North Pacific.

Forts were thrown up at each side of the entrance of the Amoor, and also at Mariinsk, and thus the trading posts were converted into strong military positions.

Collins, who voyaged down the Amoor in 1856-7, mentions seeing off Nikolayevsk the hulk of the little "Aigun." She was not iron-plated nor did she carry a monster gun, yet she accomplished a great mission and fulfilled a great end. The secret of Russian strength at Petropaulovski, and, therefore, the chief cause of our failure, she well deserves special mention and remark. The lesson of her origin and of her brief career should not be neglected by those who, like myself, are students of a great subject.

At the close of the Crimean war, there were no military posts between Shilka—or Shilkinskoi Zavod—and Mariinsk—some 2,000 miles apart, but communication was kept up by steamers. Of the former place, Atkinson,¹ referring to its mineral wealth, says:—"Here both steamboats and their machinery can be advantageously 'constructed several of the barges were built here for "the first expedition down the Amoor, and here also the party was "fitted out with all necessaries and military stores for the voyage." Collins, who visited this place in 1857, alluded to two steamers which had already been built there, and speaks of many barges in course of construction. He also mentions the drilling of troops, and says the river at that point is 600 yards in width, with a depth of seven feet over the shallowest bars in a very dry season. He calls Shilka the dockyard and naval and military dépôt of the Amoor, and describes the departure from thence of the advanced guard, 1,000 strong, of Muravieff's second expedition down the river in 1857, which having been fortified by the blessings of the priests, took its departure under a salute from two gunboats lying off the town. Taking these facts in connection with the resources of Petrovsk, where, twenty years ago, there were "iron and machine works," and where "guns were bored "and cast under a very clever superintendent, having several intelligent subordinates"—it is evident there are 2,200 miles from the sea sources of war strength which cannot be overlooked in studying the questions of development in the North Pacific.

At Nikolayevsk, Collins found "anchor chains, guns, hulks, engines "and machinery lying on the beach or preserved in temporary magazines." He remarks that "the site is badly chosen except as a port "of defence," and he estimated the population of 1,500. Mr. Knox,² speaking of it in 1866, says: "The fourth of the inhabitants are

¹ Atkinson's "Amoor."

² "Harper's Magazine," August, 1868, and "Finlay's North Pacific Directory."

"directly or indirectly in the service of the Emperor. It has a naval establishment containing machine shops, foundries, warehouses, and 'factories.' But so far back as 1858, though it had only been established as a naval base three years before, Mr. Tilly¹ in speculating on its probable future, says, 'Whispers were already afloat that it "was to be abandoned for a more favourable spot." This whisper of 1858 was in 1873 an accomplished fact, for Captain Bax² mentions that many officials had commenced removing to Vladivostok, and a great deal of the machinery of the dockyard had already been sent down.

Now, at the close of the war, neither Nikolayevsk nor the 2,200 miles of river between it and Shilka were properly speaking Russian territory, unless nine points of the law of treaties be military force. With this, however, we have here nothing to do. In 1857 the whole coast of the sea of Okhotsk was created "The Maritime Province of Eastern Siberia," with Nikolayevsk as capital.³ In 1858 Muravieff signed the treaty of Aigun, which Tilly tells us "was completed in three days in the businesslike manner said to be peculiar to that statesman in his relations with Oriental Powers." By this treaty Russia gained "the left bank of the Amoor down to the Usuri," and both banks below the junction of these two rivers. The Usuri formed the western boundary of Russian territory lying to the south of the Amoor. This river flows out of lake Khinka, and from that lake to the sea the boundary was left undefined.

Ravenstein says by the end of that year some 20,000 souls of both sexes were settled as colonists on the Amoor. The military forces exceeded 7,000, and the twenty-seventh equipage of the Navy then had its head-quarters at Nikolayevsk. The seamen of this division may retire after 15 years' service, when they receive a plot of ground, 22*l.* 10*s.*, and permission to send for their families, which are conveyed to them at government expense.

In 1860 another treaty was signed, which settled the undefined boundary and gave Russia a seaboard down to the river Tumen, in lat. 43° N., and consequently a magnificent indented coast at the southern extremity. The same year Muravieff went to Japan, escorted by twelve Russian men-of-war, to seek for the cession of the southern half of Sakhalin—the northern half had been previously occupied. He was not then successful in his mission, but in 1875 Japan gave up her share of the island to Russia. Referring to this, Wallace⁴ says: "This acquisition is useful merely as a penal settlement, and any further advance in this direction can easily be stopped, if it should be considered necessary: an arm of the sea deep enough to float an ironclad paralyses her expansive power! . . . encroachments on the Chinese Empire could not be so easily prevented . . . though she may covet certain islands of the Japanese group there is

¹ "Japan, Amoor, and the Pacific."

² "Cruize of the 'Dwarf.'" Captain Bax, R.N.

³ Afterwards changed to Sofyevsk, and again to Khabarovsk, at the junction of the Usuri with the Amoor.

⁴ "Russia." By Mackenzie Wallace.

"little chance of her obtaining them." It is not necessary to refer to the sale of Alaska, and therefore having concluded a very meagre historical sketch, it is time to take a very rough survey of the territory to which it chiefly refers.

General.

It would be out of place here to dwell upon the resources, agricultural or commercial, of the region of the Amoor. The most detailed and ample information will be found in Ravenstein, Atkinson, Collins, Schrenk, Williamson, and many other books. The possible development of such resources appears to have no limit, but the want of population and the inaptitude of Cossacks and Russians generally for commercial enterprise or agricultural energy, are drags on the wheels of rapid progress. On military grounds, however, we should not shut our eyes to the fact that great development is not only possible but is, after all, but a matter of time.

Professor Schmidt¹ found coal in the valley of the Aigun and Upper Onon, and reports good brown coal in the White Mountains. A coal mine of the Aigun was, in 1859, worked to a depth of 30 feet.

At the southern extremity of the Russian seaboard is Possiette Bay, the harbour entrance of which is so narrow, says Captain Bax, "that "it can easily be defended by a small force." Professor Schmidt remarks: "The coal here is in three separate layers in clay and sand-stone rocks, and is very difficult to get to the water; the largest "seam is four feet thick, and this coal is closer than that of Dni."

Some 60 miles further up is the Bay of Peter the Great, once Victoria Bay. It is, roughly speaking, divided near the centre by Muravief Amursky promontory, formerly "Albert Peninsula," and on the two gulfs or bays thus formed, Professor Schmidt found coal. The southern end of this peninsula is separated from a group of small islands by a channel called the "Eastern Bosphorus;" and here stands Vladivostok, or the Golden Horn, formerly Port May. It is described by Captain Bax as "a deep and safe harbour, well fitted for defence, "and to become the principal naval station of Eastern Siberia." There is a dockyard and a building slip for small vessels, and several war vessels are stationed here, the crews of which are landed in winter. Captain Bax says at the time of his visit, 1873, there were in the harbour three vessels of war, a government tug, and several steam launches belonging to the dockyard. "The harbour," he remarks, "is well capable of defence, and from its position with regard to "Japan, the Corea and China will be a most important station in the "event of any troubles in the East. Of this the Russians appear to "be fully aware by concentrating their forces here and making it the "head-quarters for the Siberian or local squadron,² which is under the "orders of the Governor-General of Eastern Siberia and distinct from "the Pacific squadron." The harbour is rarely sufficiently frozen to in-

¹ "Beiträge zur Keuntniss des Russischen Reiches und der augrenzenden Länder Asiens."

² Consisting, 1876, of 11 ships, 140 Officers, and 1,200 seamen. "Statesman's Year Book, 1877."

terrupt communication. It is into this bay the "Sufung" falls. Professor Schmidt travelled up it and describes the vegetation on its banks as "splendid," and he speaks of forests of deciduous trees of at least forty varieties, many of which are not found on the Amoor. It is navigable to within 70 miles of lake Khinka. The country surrounding the lake, he says, is flat and marshy, and from the lake to the Amoor flows the river Usuri, which affords ample water communication. He speaks of this route as that "on which the future of the Amoor seems to depend."

To attempt to describe or even to enumerate all the various bays and harbours between Vladivostok and the mouth of the Amoor, would be entirely beyond the scope of this paper. According to Captain Bax, the channel entrance of the Amoor is narrow and difficult even for vessels drawing but $8\frac{1}{2}$ feet.

As regards "Sakhalin," it may be as well to say a few words. Atkinson speaks of its "splendid harbours," while Schrenk says there is not a single good harbour on its whole western coast, though vegetation is better on that side than on the other. Aniva Bay is the chief indent; it lies to the extreme south, is 65 miles wide at the entrance and 40 miles deep; it is exposed to the south wind, and though its two harbours are tolerably well sheltered, they are small. Schmidt, who explored the island, continually alludes to the want of safe harbour accommodation anywhere near the coal deposits. These coal deposits are described by him pretty much as follows:—

At Tamavo, on the north-west coast, just opposite the mouth of the Amoor, "seams 2 to 4 feet thick which, unfortunately, is a bad brown 'coal, it burns badly and leaves a great deal of ash.'" Further south, opposite Castries Bay, is Dui. The end of May and the beginning of June is, he says, the busiest time at Dui. The steamers of the Siberian flotilla arrive to provide themselves with coal. Later in the year they come but seldom. It has also become a very important station for native commerce. The quality of coal varies according to the seams from which it is taken. Some is hard, black, and shining, without much admixture of foreign substance. Most of the coal burns well, though it crumbles so that it can only be loaded in sacks. No coal seam is more than four feet thick. The shipping of the coal is attended with much inconvenience. Steamers can only come from Castries Bay in quite calm weather, and are obliged to lie two or three days, and often longer, about 1,100 yards from the shore to receive the coal, which has to be brought to them in flat-bottomed boats, which can only go out in very still weather. Still further south, near Sakota, "a coal station was founded, which has had good results, but which labours under the same disadvantages as Dui. There is no safe anchorage for ships. " Further south again, at the mouth of the Nagaski river, there is a "coal seam four feet thick, which rises almost vertically to the height of the mountains. The river is about four feet deep, so that boats which take the coal to the shipping have convenient places of departure." There is also coal at Naybouchee, on the east side of the island.

Before passing from the subject of coal, I wish to draw attention to a fact I cannot at present account for. I find from Australian statistics that recently Petropaulovski has been getting coal from Australia: 8,000 tons were sent there in 1875. Taken in conjunction with other circumstances it is a curious fact, and worthy I think of note.

Let us now for a moment turn to the opposite coast of the North Pacific. We last glanced at its condition in 1847. Thirty years have converted these "little known and still less heeded coasts" into great centres of advancing civilization. "Sitka," says Whymper,¹ "in the 'hands of a Russian company, and Sitka in the hands of its new 'owners, are already very different things; . . . for a small log 'house 10,000 dollars (£2,000) is asked." Passing into British territory the face of nature itself is changed—gaslit cities, houses of parliament, mines, huge commercial interests, and an English population reckoned by thousands, all have sprung up as if by magic in this short thirty years. What is here is a monument to British industry and energy—what is not here may well awaken grave thought. Conspicuous by their absence are any means of defence.

The original cause of attraction was gold. There is other mineral wealth perhaps still greater, and our great coal port of the North Pacific can be had for the asking if the request be only conveyed by the muzzles of guns.

Since 1847 as we have seen the Russian seaboard has been extended some 800 miles by re-defining her southern frontier: the same power of re-adjusting boundaries has occurred here with a totally opposite result. The American frontier has been advanced so that our channel entrance can now be commanded by American guns placed on American ground. There is an American military post at San Juan within sight of our city of Victoria; there is another at Port Townsend about 40 miles off, another at Puget Sound, and a large military port at Vancouver's on Columbia River, the mouth of which is defended by heavy fortifications. The United States are more keenly sensible than we are, that fleets without defended bases held by military force are inefficient if not dangerous weapons to trust to, and that they must not be relied on to protect fixed points. New works are now being constructed at the entrance, and for the defence of the Golden Gate.

Following the coast downwards, San Francisco, or, as the Americans call it, "the Queen of the Pacific," has arisen out of what thirty years ago was a splendid yet unknown wilderness. Here now is the United States Naval establishment of Mare Island, to which Admiral Porter² in his report attached such vast importance. It is worthy of special remark that San Francisco, with its magnificent lines of steamers, receives a large proportion of its coal from Vancouver's Island! From the south of the United States to the Equator not much change has been wrought by thirty years, and casting our eyes across to the Philippines we find no new developments of war power.

The means of repair have been improved at Hong Kong, but it still

¹ "Alaska." Whymper.

² "Annual Report of United States Navy, 1871."

remains a solitary unarmed sentinel; while being a dépôt for that new war element, coal, its importance has increased. Either it is assumed that our fleets will have in war nothing to do but to patiently watch their coal stores, or that our prestige is amply sufficient to screen them from capture or to save them from being fired. Meanwhile, China has developed elements of maritime strength. The erection of a naval arsenal at Foo-Chow was commenced in 1867. It now covers 117 acres of ground; has all modern appliances, such as a patent slip and plant capable of hauling up a ship 300 feet long, and 2,500 tons displacement: it has rolling mills, foundries, steam hammers, &c., &c., and, moreover, has turned out 15 war steamers with an aggregate displacement of some 15,000 tons, and carrying in all 75 guns. This Institution¹ is indebted to Captain Cyprian Bridge, R.N., for a most interesting and valuable communication relative to this arsenal. A perusal of that short paper calls up serious reflections, when what the Chinese Empire has done and is doing is compared with what our own Empire has not done nor thinks of doing in the Pacific Ocean.

But we need not go all the way to Foo-Chow to study celestial naval development. Barbarian officials, at the mouth of their own Tyne, were recently afforded an opportunity of gathering some useful practical hints on certain elements of naval power. The *Times*,² referring to the trial of the "Gamma," says, "the Chinese Government "has given us the opportunity of keeping up to date an invention of "much value to this country in particular. . . . The experiments "with the Chinese gunboat are of interest in two senses—1st. As "throwing further light upon the problem of mounting heavy guns "afloat. . . . 2nd. As showing the farthest step to which a "valuable type of vessel has been advanced."

Nor is Japan behindhand in this direction. Last year she possessed two ironclad corvettes and two wooden corvettes, and she has building or fitting out in England three ironclads, one of 2,500, and two of 1,700 tons.³ The Mikado spent the greater part of last New Year's day in inspecting the Imperial Naval College, where he saw among other things naval heavy gun drill, and witnessed practice from 7" m. l. guns, worked by cadets of his navy. The *Spectator*,⁴ referring to this, says, "Japan may well congratulate herself on having so "quickly acquired a large body of Officers as well trained and as "efficient as these cadets showed themselves to be" that day. Over and above all this the naval means of repair in Japanese territory may, perhaps, be considered as likely to offer superior advantages to any other in the North Pacific Ocean.

Before considering our naval and military position, it may be as well to glance at those interests which in war we must defend in the North Pacific. Be it remembered that the power which can rule the North may rule the South Pacific. I will not refer to those English nations lying to the south of the equator, except to remark that last year the value of exports and imports of Australia and New

¹ *Journal*, vol. xx, No. 88.

³ "Statesman's Year Book, 1877."

² 29th January, 1877.

⁴ 10th February, 1877.

Zealand was just double that of the whole United Kingdom during the year Trafalgar was fought.

On the west side of the North Pacific 87 per cent. of the export and import trade of China is absorbed by the British Empire, and Hong Kong accounts for about 25 per cent. of the whole. On the eastern side the aggregate tonnage of shipping entered and cleared from British Columbia was in 1874 some 312,000 tons, of which 80,000 tons were British. The total value of exports and imports was over £800,000, of which over £212,000 was going and coming to and from the United Kingdom. If in addition the whaling trade; the large carrying trade done by British vessels between other countries; and the continuous stream of our food supply which has its source in this region of the world, it is no exaggeration to say our interests are enormous. Their protection, therefore, is a matter demanding very careful consideration in view of these facts:—

1st. A great military power has, after centuries of persistent efforts, established itself in the north-west.

2nd. The coast line, the interior, and the communication with the interior, are all capable of developing great maritime strength.

3rd. The naval and military development are out of proportion to the commercial and industrial progress of that region.

4th. Both China and Japan are no longer elements which can be entirely ignored.

5th. There is an immense power lying to the east, flanking our imperial lines of communication.

6th. It is the only quarter of the globe in which our naval operations have been complete failures.

In dealing with matters relating to our naval and military position it is quite impossible in a short paper to do more than roughly indicate a few general principles, which appear to demand primary consideration. Power of concentration may, I think, properly demand first consideration. It depends upon two things, the nature of the communications and the amount of movable forces available. Under this head, therefore, it is necessary to refer—

1. To telegraph lines by which orders can be conveyed. 2. To the routes and means of transport by which forces can be moved.

From St. Petersburgh to Vladivostok there is a continuous wire, and the latter place and Nikolayevsk are similarly connected. There is a submarine cable from Vladivostok to Japan, and there is a project on foot to connect Vladivostok with Vancouver's by means of a submarine cable having an intermediate station at Atka, the largest of the Aleutian Islands, and on which some indications of coal have been observed. Hong Kong is connected by submarine cable with London and Japan. On the latter line there are two land stations at Amoy and Shanghai. Vancouver's Island and British Columbia are connected by a land wire with San Francisco. They form, as everyone knows, a part of the dominion of Canada, but a message sent from London or Ottawa can only reach this part of our Empire through the United States. In the unhappy event of war with the States, the first intimation the great coaling port of the North Pacific would have of probable

attack would be telegraphic isolation. A British squadron, if there at the time, might get but half a message or a false order, and then the wire would be dumb. The nearest point at which telegraphic communication with the Admiralty could be re-established would either be Panama or Japan, and what might or might not occur while a steamer went to either place to ask for the other half of the message, or to enquire as to the correctness of the order?

It must be remembered that both the American line to Mare Island and the Russian line to Vladivostok are safe from all interference. The same cannot be said of telegraphic communication with Hong Kong. A very harmless-looking unarmed steamer could without difficulty throw Hong Kong as a telegraph station "out of gear." Telegraphic communication with naval bases has, through Mr. Donald Currie, recently attracted the attention of this Institution, and, through it, that of the press and public. It is a very important element, and some eleven years ago, in dealing with questions connected with the protection of our commerce, I referred to it to prove the necessity of developing the self-sustaining powers of naval bases. I confess to thinking its application to the *operations of sea-going fleets*, a most difficult and complicated problem, and not without its own peculiar dangers. The opportunity it would afford the Admiralty Board, thousands of miles away and already over-burdened, of sending a continuous stream of detailed *instruction* to the commanders of sea-going squadrons would not be without possible drawbacks. If naval history proves anything, it proves this—that the commander of a sea-going fleet must have full discretion, and that his success will be proportionate to his self-reliant genius. To tie that quality up with coils of cable may not always be advantageous. On the other hand, as a means of affording simple information, the telegraph must play a most important part in naval warfare, and particularly as regards making known pressing wants, such as force, coal, &c., &c. In my humble judgment, where the line must be submarine, I would put telegraphs after, not before the local defences of a naval base, which are necessary to render it *absolutely* independent of the protection of its sea-going fleet, and thus to leave that fleet entirely unhampered and free. In the case of British Columbia, there can, however, be no room for doubt, for the wire could run through British territory, and I conclude this brief sketch of telegraphic communication by drawing special attention to the following general considerations. In the event of war with Russia or America, both these countries could in a few minutes put forces in motion, at or close to their respective seabords. The Russian peace system of cruising is usually by squadrons, while our mode of protecting commerce or peace cruising is on no fixed system. Our ships are scattered on a station at points far apart from each other. They have to be collected by sending other vessels after them and thus, while Russia or America can in a few moments put forces in motion on their Pacific seabords, we cannot combine our naval forces in that ocean for weeks, perhaps months. Even if we had telegraphic communication with our naval bases, our present system and peace arrangements would, on

the outbreak of war considerably detract from the advantage which such communication would afford. While dispatch boats or other vessels were steaming over a station to get a squadron together at a certain rendezvous, the circumstances which determined the point selected might have entirely changed, and thus the opportunity for striking a decisive blow might be lost, or protection to some point come too late. Turning to the question of routes and means of transport, and looking to the western side of the North Pacific, we are, as compared with Russia, at a disadvantage. Vladivostok, Nikolayevsk, Castries Bay, can all draw elements of force from a point 2,200 miles inland by water communication which flows towards them. In winter such means of communication are closed, but, says Williamson, "The 'winter is very enjoyable; you can scour the country in all directions, "marsh, lake, or river, presenting no obstacle. Carts go in a straight "line wherever they please, and it is during winter that the great "bulk of the pulse-crop is brought to the seaports." The intervening country veils from view any preparations in progress at this inland naval base. The sources of Russian maritime strength are in the true sense of the word, localized. Not only is it possible for her to sustain a fleet, but it is possible for her to create a swarm of small steamers, and to arm them independently of the resources of her European dockyards. Whatever naval stores, supplies, or means of repair we happen to have on either side of the North Pacific are, so to speak, lying on the beach; there never can be any mystery as to their state and condition. Our fleets are dependent on *home dockyards* for succour and reinforcements, there is no local power of support, no local means of expansion. I believe I am correct in stating that even in such a small matter as gunpowder, there is no such thing as a British powder mill in the whole Pacific Ocean. If we turn to the other side of the ocean, the relative position of England and the United States is too apparent to require special remark. Bermuda and Halifax are the two imperial fortresses designed and maintained as bases of naval operations in the event of such a calamity befalling the world, as a rupture between two English-speaking peoples; but we utterly neglect the North Pacific. Our North Pacific fleet struggling without a base against the war power of the United States would indeed be a "spectacle for the gods." Taking into consideration the distribution of coal, Vancouver's would certainly be the first point of attack. If it is to be left to the protection of a sea-going fleet, the line to Australia must be left open, till reinforcements from England can struggle round the Horn.

This allusion to the attack and defence of fixed points brings us to consider the purely military element involved in this great question. The power of purely military concentration at the points of departure, or of resistance, should be considered next to that of the combination of purely naval elements at those places. In the case of Russia, the line of military posts stretching from the Caspian to the Pacific provides the force. Captain Burnaby states the military force of the district of Eastern Siberia alone to be 18,673 men.¹ The ample water

¹ "Ride to Khiva," page 183. Through an American gentleman I learn that the

communication affords the power of rapid concentration. The power of launching military force on the Pacific will increase as regards time, in proportion as artificial means of communication are super-added. The Siberian Railway Scheme is not only placed at the head of all projects of Russian railway extension, but was by the Special Commission of 1875 reported as "*most urgent.*"¹

Once a military force is on the Pacific² shore it only requires means of transport to move to attack. The providing of such transport only involves—1st, the pre-arranged diversion of ordinary trading steamers from Japan or United States; 2ndly, their purchase. Early in 1854 Russia took care to provide sufficient means of transport in these regions, and found no difficulty in moving considerable bodies of troops by sea. She has since much increased her steam transport power.

In the case of the United States the Pacific railway and its branches ramifying throughout the whole country would pour into San Francisco, as from the neck of a bottle, the national military power of America. Means of transport to any amount are ever in that harbour.³

Now, in view of such considerations as these, some may say these ports would be at once sealed by our blockading them. Putting aside all arguments for or against the possibilities of effective blockade in these days of steam, the very essence of the whole question lies in a true, fair answer to *this* question, viz., have we, or are we under our existing arrangements ever likely to have, means at hand to blockade effectually and at once either the Russian seaboard or the American ports on the North Pacific Ocean? Could we possibly do so before expeditionary forces could take their departure? To do so afterwards would be useless, unless the fallacy be assumed that we have no commerce and no weak points to protect. Let it be remembered that in the matter of time, telegraphs, railways, rivers, our past history, and our existing arrangements, are each and all against us.

Remembering this let us now very briefly consider our purely military powers of concentration to resist attack on possible naval bases. The fleet neither can be relied on nor can be used for the purpose. Major-General Collinson, to whom this Institution is so deeply indebted, has already pointed out the importance to us of establishing a strategic position near the Japanese Islands, and has drawn attention to the effect Russian and American developments have had, and are having, on the strategic value of Hong Kong. I hope he will not consider it presumption on my part if I venture to take this opportunity of declaring my earnest support of his views on this most important matter. The fact that in war our China fleet must draw coal either from Vancouver, New South Wales, or home, is a very serious matter indeed. One of the greatest difficulties we shall have to grapple with number of men in garrison at Vladivostok is 3,000, a large portion of which are seamen.

¹ "Statesman's Year Book, 1877."

² A Central Press telegram which appeared 15th February stated Russian troops were concentrating at Vladivostok.

³ The number of United States steam vessels *belonging* to Pacific ports was (1875) 245.

in war, and must now prepare to meet, is the protection of our coal lines; and considering that Russia has coal of her own in these regions, the absolute necessity of our possessing coal mines of our own in Chinese seas is too apparent to render it necessary to say more. I would also venture to draw very special attention to the very important part the Sandwich Islands must play in maritime war in the North Pacific. The care taken by the captain of the Russian frigate "Diana" to obtain the issue of a proclamation of neutrality immediately before the declaration of war reached our Pacific fleet in 1854, sufficiently indicates that the Russian Government is not blind to the strategic value of these islands. Lying as they do between the lines of inter-communication between our Pacific colonies, they command them. To keep strictly within the limits of my subject, however, I must confine myself to the points we have, and therefore confine my remarks to Hong Kong and Vancouver's Island.

The ordinary garrison of Hong Kong is about 1,000. If we take Hong Kong and Kowloon together the population is some 133,000, out of which only 6,000 are Europeans or Americans. It is no uncommon thing for 12,000 Chinese emigrants to pass through Hong Kong in a single year. It would not, perhaps, attract much special attention if a few thousand came from the far north. Now, Professor Schmidt tells us that the district surrounding Vladivostok is strewn with Chinese settlements, that these people, though Chinese, call themselves Man'sa or free people, that these settlements were rapidly extending in the newly-acquired territory between the Ussuri and the sea, and these Man'sa were looked upon as Russians. We cannot altogether shut our eyes to facts like these, nor should we forget Allum the baker. All our means of repair, stores of supply, and all our coals are here. And under certain contingencies the presence of some thousands of Man'sas—whose arrival might attract no immediate suspicion—might increase the work of the small garrison, especially if the Man'sas had a natural desire to spread the blessings of freedom they have enjoyed, and a patriotic wish to give "autonomy" to Hong Kong.

The want of a strong war garrison for this point may, in certain contingencies, become a "burning question;" Hong Kong is not alluded to in our mobilization scheme.

Singapore is 1,500 miles from Hong Kong, $7\frac{1}{2}$ days' steam. Perhaps in a great emergency some infinitesimal help could be obtained from thence. Vladivostok is about 1,600 miles, 8 days' steam; the Man'sas might get large aid thence. According to the *Overland China Mail* the powder magazine is exposed, and there is not a single fortification that could prevent an enemy's ship from entering the harbour at either end. I am fully aware that the magic word "torpedoes" is now supposed to cover every such deficiency and every such defect here, and indeed all over the world. The "mitrailleuse" was to do everything for the French, but the experience of 1870 proved that the true value of scientific appliances in war does but follow, and is dependent on very commonplace things, such as the practical application of the old saying, "a place for every man and every man in his place."

The next point to consider is Vancouver's Island. There is no time to enter into the *natural* though neglected advantages this place affords for a naval base. I must, however, briefly refer to the coal mine of Nanaimo. In 1875, the out-put was over 110,000 tons. There were three companies at work, with plant including eighteen engines, six steam pumps, and communication by railway with the coaling wharves, which are 500 feet long, with a depth of water sufficient to permit the largest Pacific Ocean steamer to come alongside. The director of the Canadian Geological Survey pronounced "the Canadian Pacific coal field to be of vast extent." Now, the established garrison of—not Nanaimo, nor yet of Vancouver's Island—but the whole territory known as British Columbia consists of 200 local militia, composed of two companies of infantry and a half battery of artillery. By the last Inspector-General's report, 1876, it appears but 7 Officers and 69 men was the strength of the force at the last inspection—that the clothing was worn out, and that ammunition for the guns of the half battery of artillery had only been supplied very recently, and the friction tubes, the only ones procurable, were "entirely unsuited to the guns"! There is no doubt about the efficiency of the *personnel* of this force so far as it goes, and it is well it is so, for if ever attack should come, it will be the military forlorn hope of our empire of the sea in the North-East Pacific Ocean. No reinforcements, no stores, and no succour can reach that loyal band. Not even torpedoes can come to its rescue, for the whole channel entrance does not belong to us. In the case of war with America they could not stop the advance of military force turning the flank of British Columbia. In case of war with other Powers we could hardly intrude torpedoes into waters which do not belong to us, nor blow up an enemy's ship within three miles of a neutral shore. So far as I am aware, there are a few guns lying unmounted at Esquimalt, but Nanaimo is as it was when described by Captain Mayne, R.N., 1857, in the safe keeping of "the Company's "old bastion, on which are mounted the four or five honey-combed "12-pounders with which the great Fur Companies have been wont "to awe the neighbouring Indians." I do not know a more unique practical example of the true value of the theory of "home defence" indiscriminately applied, than the fact that it is expected 200 Englishmen, 15,000 miles away from reinforcement or help, can keep at bay the whole war power of the United States, or defy any expeditionary force Russia might be able to dispatch either from Vladivostok, Nicolayevsk, or Petropaulovski. A steamer leaving the latter port and averaging eight knots would be in Nanaimo in fifteen days. Reinforcements, &c., can only reach it through the Straits of Magellan. A steamer with the same speed leaving Plymouth could not reach Nanaimo much under eighty days. There is no mention of Vancouver's in our mobilization scheme.

Such then, so far as I am able to learn, are our military preparations for defence in the North Pacific Ocean. The Canadian Pacific Railway is not marked "most urgent," it has been simply shoved aside by our Empire and considered as a Colonial speculation which

might not pay. British Columbia is too out of the way to be considered, it must take care of itself—and take care of "our heritage 'the sea'" as well!

Preparations are in progress for the construction of a graving dock at Esquimalt, and when it is finished the responsibilities of the 200 loyal Canadians in war will be doubled. If there are no sick, 100 will be available for the defence of the dock, and the other 100 must be responsible for the protection of Nanaimo, while Victoria and New Westminster are being requisitioned.

As regards naval preparations, we have always on Chinese waters, and also between Vancouver's and Cape Horn, fleets ample for peace purposes. They have no power of expansion in war. There are naval stores at Esquimalt sufficient for two years for three ships. Owing to the absence of any fixed system of patrolling in peace—it would be hard to say, on an emergency, how soon our Pacific fleet could be concentrated on any given point, probably not for a couple of months.

Conclusion.

This historical sketch opened in 1513 with the discovery of the Pacific. The preceding year Henry VIII had created the Admiralty Board in happy ignorance of the existence of that ocean which covers two-fifths of the whole world. That Board exists to this day, and on it rests huge responsibilities. They range from a tiny detail of boat construction to the principles and practice of a strategy which must hold the globe in its strong grasp. It must protect a commerce as boundless as the sea, and secure the communications of an "Empire "on which the sun never sets." We expect it to do all this without either an "Intelligence Department" or a "Mobilization Scheme." Great importance is attributed to applying the principle of localization to military forces settled down in the shires of England, while but little heed is taken of the fact that the support, the supply and the maintenance of our fleets all over the world is centralised under the roof of the Admiralty in Whitehall.

We have spent millions on extending the dockyard accommodation and resources of home dockyards—as the *sole base* of operations which must cover the world. We are content to leave the Great Pacific Ocean, with its 70,000,000 square miles of water, to the care of scattered ships without any local power of expansion, without power of self-support, without adequate means of repair or stores of supply, without even a sufficiently protected base or any fixed system or plan of operations. If in these days an army marches on its stomach a fleet cruises on its coals, but as I have so frequently pointed out,¹ we leave our coal lying about the world in unprotected positions at the mercy of any passing cruiser. I think I am quite correct in stating that if war breaks out to-morrow it would find our fleets without any system by which their supply of coal could be assured, when communications would not be perfectly safe. All these matters and things

¹ *Vide "Protection of Our Commerce, 1866," "Imperial Strategy," Journals of Royal United Service Institution and Royal Colonial Institute, &c.*

it is expected can be arranged for at any moment, by the happy inspiration of the surviving representative in the direct line of that Board which Henry VIII created, ignorant of the existence of more than half the world.

It may be said it was absolutely necessary to spend millions on our home dockyards to meet the exigencies of a great naval war. When that event happens the enormous resources of private firms, situated within a few miles of such dockyards, will be, as regards private work, almost idle, while between our fleets and squadrons abroad and their dockyards oceans intervene. If I may revert to my very old theory—it more than ever appears to me now that had one half the money which has been expended on dockyard extension at home since I humbly made the suggestion—ten years ago—been expended on the creation of a real dockyard in the other hemisphere, our naval position would be incomparably stronger now than it is. When a Royal dockyard on the Thames was practically abolished, a fitting opportunity offered for seriously considering the necessity for an Imperial dockyard at Sydney, and a strong naval base in British Columbia. As science and mechanical contrivances advance so must the necessity for real, substantial, and complete means of repair increase. Our fleets and squadrons in this great Pacific Ocean may call means of repair like “spirits from ‘the vasty deep :’ the question is “will they come when they do call ‘for them ?’”

These great home dockyard extensions are an index and a solid sign of a national belief that we must be prepared for a great naval war. Let us for one moment turn to the purely military aspects of such a contingency. As many years ago I ventured to point out from this place, we cannot carry on a naval war without all our naval bases and coal depôts being strongly garrisoned by purely military forces, but our mobilization scheme does not even mention a single naval base, does not provide for the security of a single coal depôt. If we were plunged in a naval war to-morrow, and there are not sufficient garrisons forthcoming at once, the action of our fleets would be paralysed by having to protect their own bases from possible capture. The Admiralty would apply to the War Minister for garrisons for the Imperial strategic points, the War Minister would apply to the Admiralty for means of transport for troops and military stores perhaps to be sent elsewhere.

Standing at the edge of that ocean of administrative responsibility, which has neither been fathomed or explored, the War Minister, like Nunez, may look over it towards the Admiralty, whilst the Admiralty, far beyond his official view, may be like Albuquerque at the other side in the great “straits” of construction and “intent, “ perhaps, on being about to produce the most magnificent ship in the “world.” Thus, in the administration of our Imperial war, power is the opening history of the Pacific Ocean reflected. Following that history, we have seen on one side steady, persistent naval and military progress; on the other, a great nation with infinite resources recently tried in the furnace of a great war. Between them lies part of that vast ocean on which British commerce predominates, where there are

interests of stupendous magnitude, and on the shores of which are thousands of English homes.¹ How best to protect that commerce, to secure those interests and to guard those homes, is neither a purely naval nor a purely military problem, it is a complex question only to be solved by a true application and a just combination of both services.

While the military mind apparently fixes itself on matters which ignore the fleet, and the naval mind seemingly overlooks the Army, and the eyes of the press and public are fixed on Turkey, it may be perhaps as well to have thus drawn attention, however inadequately, to a subject which refuses to separate the services or to divorce two elements which are helpless by themselves.

When we boast of our material wealth, our resources, and our scientific skill, let us remember they are for war purposes at present localised in these small islands, while the area of their application must extend over the whole globe.

When we proudly point as a proof of all these things to the most magnificent ships in the world, let us remember the story of the little "Aigun."

Those who take no heed of arrangements for combining naval power with military force should remember this, that on the 4th September, 1854, on the Coast of Kamschatka, English and French blood was shed like water "as a testimony against them."² On the desolate shores of Avatchka Bay may still be seen the graves of those who that day fell, helpless victims to this very principle, truly applied by our enemy, a willing yet useless sacrifice to their own country's neglect of Russian development in the North Pacific Ocean.

Mr. KERRY NICHOLLS: Mr. Chairman, ladies, and gentlemen,—I did not suppose for one moment that the honour of opening this discussion would devolve upon myself. I am desirous of saying a few words upon the very able paper to which we have listened, as I have travelled over nearly the whole of the ground laid down. Captain Colomb has referred to our naval position in the China seas, and the North Pacific, and I think, considering the vast interests which we have to protect, not only as regards the development of industry and trade in China, but likewise in regard to the encroachments of Russia in the north, that our position in Hong Kong is not so strong as it might be. We have the fact that Hong Kong, although a magnificent position, viewed as a strategical base, is at the same time entirely unprotected, although the inhabitants of Hong Kong, I think, contribute £20,000 a-year for their defences. Captain Colomb has referred to the subject of coal in this part of the world, and I think that that is one of our great features of weakness in regard to Hong Kong. Our squadron in those waters, which has at the same time to protect our interests in the treaty ports of Japan and China, is dependent for its coal-supply upon the Australian colonies, 5,000 miles away. Captain Colomb has pointed out to us the advantages which Russia has in the possession of coal in the island of Saghalien, which she purchased two years ago from the Japanese Government on account of its deposits of coal and iron. He has also pointed to the fact that Russia in that part of the world has received from the Australian colonies 8,000 tons of coal during the year, and he would like to have an explanation of that. I might presume to advance one, and it is this: that the coal mines of Russia in that

¹ I am informed, on reliable authority, that in British Columbia there is within range of the guns of an enemy's cruiser £3,000,000 worth of British property.

² Total killed, wounded, or missing in the Allied squadron, 215.

position are comparatively undeveloped, and that the coal at this period is of comparatively an inferior quality, and in order to adapt it for steam purposes, they have recourse to the Australian coal, which is of very superior quality. That, I think, will explain the difficulty; but we must not lose sight of this: that as these mines become more developed, the quality of the coal will no doubt improve. It is suggested that it would be desirable to procure a position in the Japanese islands, to strengthen our coal supply. We know that coal mines exist at Nagasaki in Japan, but coal is by no means uncommon in China. There are vast deposits of coal on the Yang-tse-Kiang, not far from Shanghai. There is a point I am desirous of alluding to at the present time with reference to the island of Formosa. Formosa is situated 100 miles to the north of Hong Kong, and 80 miles from the mainland of China. It has an area of 14,000 square miles, and a fine harbour at its south-western extremity, in the neighbourhood of which there are some very rich coal deposits, and if we could obtain a concession of some of these coal deposits, under proper development they would become of material importance not only to our position in the China seas, but also in regard to our position in India. There is another point to which I will allude before I leave the coast of China, and that is the relation that country bears to Australia and its coal supply. Australia is only briefly alluded to in the paper, and I think one of the great features would be in any future development of our naval operations on the coast of China to maintain an open roadway or approach from the Australian colonies, so that at any time we might not have our coal supply summarily cut off. With regard to Vancouver's Island, I can quite appreciate the immense importance which Captain Colomb has attached to that as a strategical point. The vast coal deposits of Vancouver's Island must render it always a strong point with us if we can only maintain it. There is no reason why Vancouver's Island and British Columbia should not become the great coal emporium not only of the North Pacific, but of the whole of western America. The whole of the western American steam traffic is dependent upon the supply of coal from Vancouver and British Columbia, and I think, in view of these immense advantages, we cannot do better than strengthen our position as much as possible in that direction. Captain Colomb has referred to the Pacific Railway of Canada, and that as a strategic base cannot be over-estimated. I have travelled across from San Francisco to New York, and can therefore bear testimony to all that has been said in favour of the Canadian Pacific Railway. The conveyance of a force from New York to San Francisco would only take about seven days, and we might, if we had the Pacific Railway, be enabled to accomplish as much for our important dependency of British Columbia.

Captain MAN: I do not know, sir, that I can add very much to the information that Captain Colomb has given to the meeting, but, as I happen to have been for some years in that part of the world bordering upon the Amoor, I may perhaps venture upon a few remarks. I think the great landmark of Russia's doings in those regions dates from the Treaty of Aigunt in 1858. Mr. Tilly, who writes upon the subject, tells us that General Muravief made that treaty in three days, but he does not tell us the lever that was used. To find that lever we must go back 200 years, to the time when Russia met the Chinese on the River Amoor, and was driven back. It sounds strange in these days to think of the Chinese driving back the Russians, but that was the truth. They defeated them on more than one occasion, and took the prisoners to Pekin, where they remained and were formed into a corps of banner-men. Russia then sent a religious mission to Pekin, with a view of looking after their spiritual welfare. The result was a semi-diplomatic establishment, which kept the home Government well informed, and enabled them, at the time when we were tapping at the gate *vis à vis* Tien-tsin, to use their influence so successfully that, while by the favoured-nation clause in the Tien-tsin treaty they gained all the advantages that European nations gained, they also, by a stroke of the pen, got transferred to them the whole coast-line of China down to the Tumen River, which divides it from the Corea. General Muravief appeared at the head of an army, and China, at her wits' end, could refuse nothing to her friends. Besides, according to the belief of intelligent and well-informed Chinese, the Russians put it to them whether their influence *vis à vis* the allied commanders would not be of great service. At any rate, be this as it may, we know the result. The whole of this coast-line was handed over. As it is now, with the entire shipboard in the hands of Russia, she has a most magnifi-

cent position. She comes right down to the Tumen River. But if you will follow the frontier line, you will see that the two northern provinces of Manchuria stand as a wedge run up into Russian territory. I do not believe anybody who knows what is going on in Central Asia will believe for one moment that Russia will be satisfied with that. I do not think it is possible that she can be for many reasons. By that same treaty of Aigunt, Russia has the right of navigating all the affluents of the Amoor. Mr. Tilly, writing in about 1870, said the Russians were preparing flat-bottomed boats to take advantage of that clause in the treaty. I know positively that they have commenced to use those boats, that they are endeavouring to force their trade up the affluents on the southern bank—up the Sungari and the Nonni. Mr. Tilly tells us that the Sungari is not navigable higher to the south than Petuna, but I can assure you that it is. The Russians have had steamers at Kerin, the capital of the province of the same name, on two occasions, and they have there attempted to open trade. The Chinese, with that clause of the treaty thrown at them by the Russians, really do not know what to do.

Captain Colomb remarked, quoting from Dr. Williamson, a very enterprising and learned missionary of the Bible Society of Scotland, that this country was frozen so completely over during the winter that the grain is carted down in that season. As far as we western foreigners are concerned—British, Americans, Germans, and French—the whole of the trade for us is during the winter months, because the tracks are perfectly impassable during the summer. But if Russia has what she claims—the right of navigating the affluents during summer—her trade will go down by boat, and we have no such right. Therefore she would have an immediate advantage over us in that respect. But supposing, what I believe some day will come true, and not long first, that Russia will overstep more than she has done already the Amoor, it becomes a very important question for us as a mercantile nation. That country, since the close of the Taeping rebellion, when by reason of the tremendous number of fighting men taken away from it, it became uninhabited, has been receiving an enormous influx of Chinese immigration. These people have done wonders for the country, and many have brought with them a knowledge of foreign articles, and of course with the knowledge, the want. Those wants are now supplied principally by ourselves at the treaty port of Tingzie, on the south coast of Manchuria. The year before last the amount of trade that went in there in foreign bottoms amounted to over one million sterling, and of that I am sure £600,000 was British. So it is of some consequence to us that we should keep that trade open, and that we can keep it open if Russia advances, is impossible. Our trade going in at Tingzie, stops where it meets the Russian line; it never crosses the frontier.

With regard to the port at the mouth of the Tumen, I believe it is not open all the year round. I am strongly under the impression that the inner bay, at any rate, is blocked by ice. I feel tolerably sure that if the outer bay could be used certainly, the inner harbour could not. I do not think it possible that troops, for instance, could be landed there during the winter months. I have been two winters in the country, and I can say that the weather is often terribly severe. It is much the same as in Canada, and during the spring, when the ice breaks up, there are tremendous fogs. I think that is one reason why Russia will not be content with her present boundary. I do not consider the port of Posiette is at all what some writers have thought it: as I mentioned just now, I do not think it is accessible at all seasons.

There was one thing Captain Colomb mentioned—the Foochow Arsenal. China has done wonders at that arsenal. Captain Bridge, I believe, wrote and spoke in this Institution on that subject. That arsenal was founded by a remarkable man—a *lieutenant de vaisseau* in the French Navy. I am sure everybody in this room who has been in China will bear me out in that. His name is Giquel, and he is now at home, but shortly going out again.

That China should increase in the way of maritime strength I for one think one of the best things that could happen. The policy of this country should be to strengthen China and Japan, particularly in the maritime line. With a strong Chinese fleet such a thing as a great slice of country, of vast importance to a nation, being handed over without anybody in the world knowing anything about it will be impossible. Just look at the Corea. There is a nation we know very little about.

They, in the most absurd way, got into trouble with their neighbours eighteen months ago, and but that the thing was stopped by China putting down the disturbances amongst the gold-miners, the Russians would have certainly crossed the Tumen. Would they ever have re-crossed it?

Mr. RAVENSTEIN: I have listened with the very highest interest to the very able paper read by Captain Colomb, and I have learned a great deal from it. Much of that which I intended to have said has been anticipated by Captain Man. On military and naval matters I shall not give an opinion, because not being a military or naval man myself, you would treat my opinions with a certain amount of polite contempt. But I say military strength and naval strength must be maintained by material resources, and on those I may be permitted to form an opinion. The country which you see marked down in his map, and which the Russians have taken possession of—the region of the Amoor, and the coast region to the Tumen River—is many times larger than Great Britain. Only a comparatively small portion is capable of being developed in agricultural respects; at the same time, near the south of the Amoor, where the Sungari enters and leads into Manchuria proper, all our European cereals can be grown with success, and though the grapes are sour, I do not doubt that the Russians when they get further south, will find them more palatable. The country possesses other advantages, which must make it of great importance in military respects. It possesses all that is needful for building ships. Near Nerechinsk you find capital iron, as much as you like. A coal-field strikes right across the Amoor region to within a short distance of Nikolayevsk, and this coal-field, which has only begun to be worked experimentally, does not contain the tertiary coal of the seaboard. It contains jurassic coal of very superior quality, and when once these coal mines have been developed, no doubt Russia will be perfectly independent of anybody else's coal supply. You have coal and iron, and, thirdly, you have magnificent forests, hard and soft woods, woods suited for the finest furniture as well as for the most magnificent ships, for though most of our ships are built of iron, iron is not the only thing that enters into their composition. The Russians have the means there of floating a navy, but what have they done to develop these means? I say, nothing. If this country had remained under the able government of a man like Muravieff, we should have to speak very differently now! but to Muravieff have succeeded others, men of less ability—I will not say of less honesty—and the country has actually made no progress since the day on which I published my book, that is, 1860 or 1861. The whole population numbers about 40,000 souls. Most of these are Russians—military settlers. What do they do to increase the population? They do not take a leaf out of the book of those New Zealand Commissioners who take away the pick of our population: who only take servant girls with the very best of characters and of the most perfect physical strength, who take our very best men and carry them to New Zealand, in order to produce there, on Darwin's principles, a fine and magnificent race. Those persons who have the management of the Amoor certainly have never studied Darwin's works, or they would not take to that region the very scum of female European Russia. Instead of importing respectable settlers, they import criminal women, and these women find husbands readily amongst the small Russian officials and the soldiers who dwell there, for those poor wretches have Hobson's choice when in want of a wife. I do think that is a bad system to follow, and it is one which has led to no success. In order to develop the resources of a new country, you must have strong, energetic people, honest people above everything, if rough people; but here you have the roughness without the honesty, therefore the resources of the country have not been developed, and instead of the Amoor sending its coal to Australia, or to other Pacific stations, the Russians from Kamtschatka have actually to go to Australia for their coal. As to the coal mines of Saghalien, that island has not a single port available for a military harbour. Atkinson says that it has; but Atkinson never was there, and the book he wrote on his "travels" is a mere fiction. There is not a single harbour, and the coal which is now being worked is certainly not being worked on a large scale; for the output two years ago only amounted to 5,000 tons. On one other point I should like to offer a few remarks, and that is on the harbour of Vladivostok. The Russians, fancying the possession of these ports would give them the dominion of the east, that is on the other side of our continent, have named the settlement which they

founded upon it "Dominion of the East." This "Dominion of the East" was visited a few months ago by the German man-of-war "Hertha," and one of the officers sent a description of it to a paper, where I read it. According to his description, the place certainly is a naval settlement. There is a so-called equipage; that means about 2,500 men, sailors and soldiers, to man a number of ships. Besides that, there are storehouses or sheds; but they have no dockyard properly so-called. They draw all the supplies from abroad, and this is very important. The minor harbour is frozen up usually from November to March. This rather astonishes me; for Castries Bay, much further north, is sometimes open to December; but all along this eastern sea-coast as far as the Russians have gone down the climate does not improve, as far as the winter is concerned. It improves in other respects, for whilst in the north we have only coniferous trees, in the south we have deciduous ones. The Russians have no arrangement for building men-of-war—no stores and no fortifications. It is the mere beginning of a town; and as this German officer found it, it looks as if it were a sort of temporary settlement, a stage for something better. They had intended to settle down there, and to convert it into a big naval station. Its capacity, as far as the harbour is concerned, would have enabled them to have converted it into a magnificent naval port; but, finding how disadvantageous it was in other respects, and hoping also that something better would turn up, they have stopped progress for the present. At the same time they are making efforts to colonise the country near. Some Coreans and Chinese fugitives live already in that country, and they seek gold in the rivers. The Russians are trying to colonise, and if you think of the immense population of Russia, if you think of the 83,000,000 or more who inhabit the Russian empire, you must admit that to colonise a country like this ought to be an easy thing to Russia; and it would be in our interest too, for rather than that the Russian population should overflow in our direction, we would wish it to overflow towards the Pacific. One other disadvantage of this port of Vladivostok is this: it has no communication with the interior of the country, and if you want an example of the misgovernment of a country, you may find it here. The Russians have now been in possession of the whole of this district up to the Kinkha Lake for years, but they have not constructed a road, and only a wretched path connects this magnificent port with the interior. Communication, in fact, is only kept up by sea, and every single article is supplied from abroad, and not from the immense country which lies behind. One of the very first things which they ought to have done would have been to have established a first-rate road to the south, in order to counterbalance that immense disadvantage of the Amoor running towards the north-east instead of the south-east—running into an inhospitable sea instead of into the hospitable sea of Japan.

Colonel CROSSMAN, C.M.G., R.E.: Some seven or eight years ago I happened to be in the north of the Gulf of Tartary, and had an opportunity of visiting Castries Bay, and also the coaling stations in the Island of Sakhalin. I quite concur with the last witness as to the class of population that the Russians send to these places. At Castries Bay, in 1868, there was a small naval station. As far as I remember, there were twenty-five wooden houses, one long barrack, and about sixty or seventy convicts, with a small garrison of soldiers, under the command of a lieutenant-colonel of the Army. The place was not fortified, but at that time their great naval station was at Nikolayevsk; but since then they have very rapidly advanced down to the south, and, of course, Castries Bay was only a mere temporary place of refuge, as Vladivostok probably is now. As to the coal at Saghalien, certainly at present, being worked from the surface principally, it is not of very good quality, although, such as it was, it was reported by several of the engineers of Her Majesty's ships, at the time, as being very fair for steam purposes. There is no doubt the whole of that coast of Saghalien is full of coal. But, on the other hand, along the whole of that coast there is not a single harbour where a ship can lie at all times. I went up in a ship that was going to take in some coal for a private Company, and there was very great difficulty in getting it on board. I remember, on one occasion, there was a German vessel which had been lying there for forty days, and had to continually beat off and on before she could get an occasional day on which she could bring the coal on board. The coal cost, I think, about 1*l.* a ton, although it was done by convict labour; and if you calculate the cost of taking ships up there and bringing

them back again, and taking off the coal which costs a pound a ton at the pit's mouth, you will see that it will be more expensive almost to get it there than to bring it out from England or from Australia. The coal is worked very badly indeed at Nyashi. The men work in very small, narrow galleries, crawling in on their hands and feet ; they throw the coal into trucks without wheels and then send it down to the shore ; but if you go further south to Yesso, at a place called Eyama, the Japanese have been working the coal mines on a much better principle. The coal is much thicker than at Dui. It crops out on the hill side, and they had a tramway made down to the water. I believe this, that Russia, having now got the Island of Sakalin, will not rest until they get hold of the Island of Yesso opposite, and that very important and one of the best harbours in these seas—a port which is always open during winter—the harbour of Hakodati, a harbour which is easily capable of being fortified and which commands the whole of the North Pacific. It has been said once or twice, that we ought to take possession of some place out there, in order to have possession of some better strategical point. The question is, how are we to get it ? We cannot go to war with China or Japan. We cannot well seize a port in Japan or the Island of Formosa. As regards Formosa, there is no harbour at Taiwan-Foo at all. It is a mere bad, open roadstead. The only good harbour in Formosa is Keelung, near where the coal mines are being worked. I do not think we can look forward to taking possession of any of these places that have been mentioned, and, therefore, the only thing to do is to make Hong Kong as strong as possible, and so secure our only strategical point and coaling stations in the China seas.

MR. STRANGWAYS : I should like to direct the attention of this Institution to the part of the paper which alludes to the question who is to pay for all the works that are required to maintain the strategic points of the empire. We had a paper at the Colonial Institute, a few days ago, from Captain Colomb, after which a discussion took place. I do not intend in any way to go into the naval or military point of the question, for a reason analogous to that which actuated Mr. Ravenstein who preceded me, that, as I belong to that profession which has the reputation of being, with the sole exception of the Army, the most modest going ; if I was to discuss military matters, I should, as he suggested, most likely be considered to be talking about things that I do not understand. But the question of the maintenance of these strategic points involves, first of all, the question of the jurisdiction over the territory on which these strategic points are situated. Now, the chief strategic points that Captain Colomb has alluded to, not only in his paper to-day, but in his paper the other night, are situated in those colonies which possess representative institutions and responsible Governments. It is a matter to which I wish especially to direct the attention of members of this Institution, because it is a point that is not sufficiently considered in this country ; and it may probably occur, when these matters come to be decided by the Government, that the opinions of a large number of naval and military men will be taken on the subject. I say that they cannot forget the constitutional points involved in it, and those are, that these large colonies are, except for one or two purposes, independent Sovereign States. They cannot declare war, they cannot make peace, but the Parliament of this country has no authority whatever over them. The Queen reigns over them, but the Parliament of this country and the responsible Ministers of the Queen of this country have no authority whatever over them. Now, Captain Colomb has alluded to the maintenance of these strategic points as essential to the welfare of England. There is another matter that is essential to the welfare of England, and there are considerations that, as Captain Bedford Pim specially pointed out a few days ago, will appeal to that part of every Englishman in which he takes very great interest, that is the part which requires to be supplied with food. It is well known that more than two-fifths of the whole necessary food of this country has to be introduced from abroad, and although there are no doubt a very large number of persons in this country who would be very greatly improved in health if they were put on half rations for twelve months, yet, on the other hand, there are many millions of people to whom putting them on half rations for twelve months would mean absolute starvation. A hungry man is not a reasoning man, and when the question of food supply comes up, as it most certainly will, then comes forward the immense importance of maintaining these strategic points. I would submit, without touching upon

the naval or military question, that it is not necessary to blockade the ports of England in order to cut off the food supplies. Our food supplies are drawn chiefly from three large sources, from Russia, Southern Europe, and from North America. Now, if such an alliance could be brought about as would induce those countries which supply us chiefly with food to unite against us, it would not be necessary for them to blockade the shores of England, it would be sufficient for them to prohibit the export of food, and by prohibiting the export, they would entirely cut off our supply. Therefore, when you see the way in which a combination can be formed against us, it becomes the more essentially necessary that such steps should be taken, throughout every part of the British Empire, as would tend to make the formation of such combination of less evil to this country than it otherwise would be. I should wish further to direct particular attention to this. Those maps do not show the whole of the British Empire, they only show a comparatively small portion of it. If you turn to the immediate left hand corner of that map, and have a tolerably powerful magnifying glass, you will be able to see the small island in which we happen at the present time to be residing. But the English Empire is seventy times the size of that little island, and the Empire of England, if such steps are taken as those which Captain Colomb has pointed out, can, with the help of England, protect itself against any combination that can be formed against it. Again, the other portions of the British Empire can supply England with every particle of food that she requires. I have alluded to these matters with a desire of impressing permanently upon you the importance of the question. I say that I believe that these great colonies will not join England in any matter of general defence, any further than they do at present, unless Englishmen, who reside in these colonies, are permitted to have equally with Englishmen, who reside within the United Kingdom, the power of having some voice in the question of declaring war or making peace.

The CHAIRMAN: We cannot touch politics in this place; we only deal with naval and military questions.

Mr. STRANGWAYS: I have endeavoured to avoid the political question so far as it had any relation to party politics. I was not going to allude to what had been done, but simply to point out to this Institution the importance of the subject, and further, that they cannot attain their end without considering those questions which I am forbidden to allude to on this occasion. I will not sin against the rules of this Institution, but I will conclude by saying, the question that is prohibited is the one great question that must be considered, and without that we cannot bring about the end which Captain Colomb has suggested, and which suggestion was received with hearty and deserved applause in this Institution.

Commander GURDON, R.N.: With regard to the coal supply of San Francisco, it draws three-fourths of its supplies from either this country or Vancouver's. Strange to say, nearly one-fourth of the coal supply of San Francisco comes from England. A large fleet (I have seen 70,000 tons of British shipping laying at anchor at one time in the harbour of San Francisco) goes out there every year using coal as ballast; only about one-fourth of the coal that they use there comes from American territory itself (Monté Diablo, I think they call it). They sell English coal there, nearly if not quite as cheaply as Vancouver coal, and there is only a difference of about a dollar in the ton in consequence of its being a drug in the market. I do not think the establishment at Mare Island, at the present moment, is of any great consequence. They have just built a graving dock, but up to that they were dependent on a floating dock with which they managed to capsize one of our frigates (the "Terriagant") a few years ago; however, the American Government has been spending a great deal of money during the last three years there, and we have no means whatever on the Pacific coast to meet them or any foreign squadron. I think it would be very wise if the Imperial Government in connection with the Dominion Government, would build a dockyard such as is necessary for our fleet in the Pacific at Victoria, Vancouver's Island, and also to establish a certain number of troops there.¹ The harbour at Victoria could be very easily defended; it is naturally of

¹ I would venture to suggest a battalion of Royal Marine Light Infantry and two batteries of Royal Marine Artillery as the most suitable; as such would be under the orders of the Admiral on the station, and the men capable of exchanging with those of the squadron.

immense strength, and comparatively very little money would enable it to defy any naval force that could be brought against it.

Mr. BROAD: With your permission I should like to express my thanks to Captain Colomb for his paper. I have a very deep stake in the Colony of Hong Kong, although I have never been there: my wife has large property there, and I certainly take an interest in everything that pertains to the advantage of that colony. I can fully endorse all that has been said by Captain Colomb, and I am glad to have heard the remarks made by those gentlemen who have also addressed us. I do hope and trust the interests of that colony will receive the serious attention and consideration of Her Majesty's Government, and that those who are so deeply engaged in mercantile and other pursuits in that colony will receive that protection which they have a right to receive at the hands of Her Majesty's Government.

Hon. ARTHUR KINNAIRD, M.P.: Having had the advantage of hearing the lecture delivered by Captain Colomb, I wish to make one or two observations in reply to what dropped from our friend Mr. Strangways. I am not going to touch in the least upon politics, but I am sure that if an appeal was made from the Government of this country to the colonies, it would have a hearty and cordial response. Have we not had a proof of that? Did not Canada come forward and show that its people were of the true old stock, by forming a most effective militia? I think that both in the Colonies of Australia and New Zealand the same spirit now exists. At this present moment, infinitely to their credit in New South Wales, the revenue is such as to show a surplus of one million, and I believe that these people, animated as they are by royal hearty feeling to the mother country, would co-operate with us in every possible way. I hope the result of this lecture will be, that the military and naval departments and the Government of this country will combine to make some appeal to the colonies, because their own interests are equally and deeply involved with ours, and I for my part, have no fear that they would heartily co-operate with us in this most important matter.

Mr. SCOTT RUSSELL, F.R.S.: I came here to be instructed and I am afraid I have very little to say that would be instructive. I have heard, with very great pleasure all that Captain Colomb has said upon this subject. I have some acquaintance, if not with the colonies from my presence there, at all events with colonial men, and I do think it very important that we should provide in the Pacific, and in the places where we have our very large colonies, or rather I would call them those very large portions of the empire, some strong strategical points on which we could concentrate, not only the military defences of the empire, but also the naval defences of the empire. And when you consider that coal is now almost as important as gunpowder, I think that next to keeping your powder dry, you should add this, keeping your coal safe. I have an objection, however, to multiplying minor points of defence; and I think we may commit a great blunder by making weak defensive preparations in minor points. I think we should only make few and strong defensive preparations, because if you put your coal and all these matters of supply, and your small ships and guns, and so on, in certain places which are too numerous and not sufficiently important and well defended, you are doing this, you are placing the supplies at points most convenient for the enemy to appropriate to themselves. Hoping then, that your points of defence will be most efficient but not too numerous, I would certainly say it was of great national importance to call attention to having powerful fortresses, very large harbours admirably supplied with all the supplies necessary for naval and military purposes in the colonies of the empire, but not little ones and not too many of them.

Commander CYPRIAN BRIDGE, R.N.: Perhaps I may be allowed to point out one or two errors in the very able paper to which we have listened. I have visited almost every place of which Captain Colomb has spoken, and as I have been quite lately at Vladivostok, I may be able perhaps to throw some light upon the subject under discussion. The harbour of Vladivostok is not closed, as Mr. Ravenstein said, for four months in the year, but for two; nor is it closed until late in December, and it is open again early in February. In proof of that I may mention the present Governor of Eastern Siberia, an Admiral in the Russian Navy, came out from Europe in the French mail steamer to Hong Kong, and went on from there quite late in November to Shanghai, in order to reach the head-quarters of his government at Vladivostok.

He could not have reached it till well on in the month of December. I was assured by Russians and other people that the harbour is open early in February, and that it is not closed for at the outside more than two months. I had the authority of Admiral Krantz, who commanded the French squadron in the China seas, for asserting that Poisette Bay, as a rule, is open during the whole year, and it was his idea that the unfinished state of the settlement at Vladivostok was owing to the fact that they were prepared to make a move still further south to Poisette Bay, where they would always have open water at every season. The dockyard and establishments at Vladivostok are certainly not what they would be supposed to be from the expression "dockyard" or "arsenal." The dockyard at Vladivostok is a mere shabby yard, enclosed by a broken-down fence, with one or two very worn-out boilers, and an extremely rickety pair of shears. Those "geometrical shanties" of which Mr. Ravenstein spoke were when I was there, eighteen months ago, rapidly approaching completion. They are very large and extremely well-built barracks and storehouses of masonry roofed with iron, but they are being built at another point of the harbour. The inner harbour, or Golden Horn, is three miles long. The dockyard and original establishment were opposite the entrance, but the new buildings of which I spoke, and which were in course of erection during my visit in August, 1875, are a mile and a half further on, or about half-way up the shore, where they are not so easily exposed to shell fire from ships as if they had been constructed in the original position. The harbour of Vladivostok is one of the finest in the world. There is the outer harbour, or Eastern Bosphorus, then the inner harbour, or Golden Horn, which turns direct to the right, with water so deep that in the ship to which I belonged, which drew nearly 24 feet of water, we swung with her stern up close in shore; we certainly were not more than 50 yards from it. It abounds in coal of a quality, though not good near the surface, still sufficiently good to be of use. We could see from the stern of the ship the seam of coal cropping up close to the water's edge. I went on several short excursions in the neighbourhood with a brother Officer and geologist, and we discovered another seam of coal a mile further inland. It appeared to him to be of a better quality than that which showed near the water's edge. We brought on board some specimens, and they were tested, and though not good, it was still of sufficient value to make it useful to get it. It would be easily worked and easily brought on board. With regard to the amount of coal Captain Colomb says had been sent up to Petropaulovski, early last year I went on board a Russian man-of-war, the captain was going round through Behring's Straits to visit the northern shores of their new possessions in Eastern Siberia, and he told us large quantities of coal had been sent up to Petropaulovski. There was no concealment about it. The coal was merely sent up to form the basis of supply for ships going up there to open up the new country round on the north shore of eastern Asia. I believe the Russians themselves in civilised Russia—St. Petersburg and Moscow—hold very much the same opinion that we do as to Russian development in the east, and they believe their country is far more developed than it really is. In support of that I can tell you the following story. When the new Governor came out to Hong Kong, he was a fellow-passenger with the Governor of Hong Kong, Sir Arthur Kennedy, and during the time he was waiting for his steamer to go on to Shanghai, he was the guest of Sir Arthur. An officer told me that when calling upon him at Government House, two Russian ladies, the wife and sister of the Governor, asked him to give them some idea of what Vladivostok was like, and he seeing that they were under the impression that they were going to a very different place to what it really was, hardly liked to say anything to discourage them. Among other questions, they asked him if the Government House there was as good as the Government House at Hong Kong, which is a very fine building, and if it had a ball-room. Now, when I was there the Government House at Vladivostok was composed of logs placed together like a Canadian log-hut, and the whole building was not very much larger than this theatre. So that, although I should be very sorry to say anything which would appear to take away from the importance of watching Russia's development in these quarters, I think it is desirable we should know that there is something to be said on the other side.

The discussion was then adjourned, on the motion of Lieutenant CHAMPION, R.M.L.I., to Tuesday, May 29th.

ADJOURNED DISCUSSION.

Tuesday, May 29, 1877.

MAJOR-GENERAL COLLINSON, R.E., in the Chair.

Lieutenant CHAMPION, R.M.L.I.: No one, Sir, is more capable of thoroughly appreciating the importance of the lecture to which we listened with such interest and attention on Friday afternoon, and to the important information elicited by the discussion which followed, than yourself. Considering that but a short time ago you showed with considerable perspicuity the facilities that were at the disposal of a well-organised hostile power for making a successful descent upon England, I think you must this day stand aghast at the totally unprotected state of our Colonies. That feeling of fear for the Colonies is shared in by a great many people, and I think it is a great pity that in our Institution we have not a custom of embodying the opinions and views of such meetings as these upon all matters of Imperial import, in the form of a resolution, because I cannot fancy for a moment that anyone in authority has either the time or opportunity to wade through the voluminous and sometimes discursive debates held in this Institution, for the purpose of arriving at the views of the scientific and experienced officers of the services, and also of many others. I hope the Council, however, Sir, will give this matter that attention which many authorities, far greater than myself, consider it worthy of. Now to the subject of the lecture. We have heard a great deal, and I think it is scarcely necessary that we should hear so very much more to convince us of Russia's aggrandisement and rapid progress in Asia, upon the Pacific side. We have also had our attention drawn, not too strongly, to our great interests in the Chinese seas, and how those interests are threatened by the Russian advance. The totally unprotected state of Hong Kong, considering its strategic position, has also been fully discussed. I think, therefore, upon these points we are fully enlightened, and thoroughly satisfied. Before I go into the more general question, then, on which the lecture touches, and into which it in fact merges itself, I will remark upon what seemed to me to be a slight discrepancy as to the depth of the Amoor River, both at its mouth and higher up. It will be in the recollection of any senior officers who are present here to-day, that during the war with Russia, after the disaster at Petropaulovski, and after the Russians had evacuated that place, there was a certain Russian frigate called the "Dwina," having on board a portion of the garrison, women and children, and quantities of stores from Petropaulovski, that was blockaded in Castries Bay by an English frigate, which I shall not name. More by good luck than good management, Sir, the "Dwina" escaped, got into the Amoor, and was towed some 200 miles, I think, up the river. The "Dwina," answered to the first-class frigates of our own navy at that time, and, I think, like them, she must have drawn at least from 18 to 22 feet of water. Giving her the mean draught of 20 feet, it is evident the depth of the Amoor must be considerably greater than that suggested on Friday, which was, I think, from 8 to 12 feet at the bar. Now, Sir, while we consider the question of the defence of Hong Kong, we need not separate that question from the wider subject of the general protection of all our Colonies and strategic positions, in fact, if I recognise the tone of the lecturer's address, I feel pretty satisfied that his desire is not only the defence of Hong Kong, but that all the strategic positions should be fully and comprehensively considered in one grand scheme, upon the security of which depends entirely our maritime supremacy in foreign seas, and the safety of our Colonial Empire. I will venture in the short time allotted to me, therefore, to offer a few general remarks upon the subject, and to make a proposal. In the first place, there is a point that seems to me to be entirely lost sight of in considering the defensive powers of this country. The defensive power of this country is peculiar and exceptional; it consists almost, if not altogether, of naval elements. We are peculiarly and singularly situated; in fact, no nation has boundaries that are so universally washed by the sea, to commence with. We have two boundaries only which are coterminous with those of other nations; one is the northern boundary of India, the Himalayas, and all that range

that stretches from sea to sea, and the other is the boundary line between the United States and Canada. With respect to the defence of the latter, we need not give ourselves the slightest anxiety, because America is peopled from our own population ; she has the same ideas, the same views, the same objects and aims as ourselves ; she is developing by the side of our own family, she speaks our own language, and imitates our own institutions to a certain extent, and she will never encourage the art of war with a view of promoting that which she knows never can follow in the wake of a warlike policy, namely—wealth, progress, and national development for her people. With respect to the northern boundary of India, I think if we govern India with wisdom, practically, and not sentimentally, if we do not allow native princes to have armies of 30,000 men at their command, and to take possession of fortresses like Gwalior, and if we keep a sharp look out on the tribes beyond the boundary, and take care that no hostile combinations are made against us without timely warning, I do not think the fate of India need cause us any alarm from that quarter. I consider that if India falls from our grasp, it will be from internal, not from external, causes. However, these are matters that are not at this moment directly connected with the lecture, and the consideration of these two boundaries will not, therefore, controvert the statement I have made, that the defensive power of Great Britain consists chiefly if not altogether of maritime elements. But in maritime powers there are, and must be, military elements, which in themselves are more or less nautical, not after the manner of an army with a distinctive department and administration pulling one way, while the naval element pulls another, not at all ; but I mean a military element that shall not only be connected with the naval elements, but actually dovetailed, as it were, into the naval elements, so that they will, combined, thoroughly complete our maritime power, and establish it beyond the seas where it is weakest. We must have the two elements working together, if we expect our defensive power to have anything like a real and stable basis far from home. With regard to these military and naval elements which make up our defensive power, we have to arrive then at one conclusion, How are we to get at the combination so desirable ? how are we to produce a naval and military combination that shall work together and make up a comprehensive scheme of Colonial defence ; for the whole of our Empire, as we have observed, with the exception of one or two very small boundaries, is almost entirely washed by the waters ? Very easily indeed. In the first place, it is a simple matter, though not a pleasant one, to fortify all our strategic points, to establish coaling stations and dockyards in proper positions, for money is the only question, and that is a matter that can easily be got over. But the point we fail in generally is in organization, and that will affect the question of manning these fortified places, and the personnel of the force required comes chiefly under consideration. Let us first of all run over the principal strategic points. Vancouver's Island, Falkland Islands, some portions of the West Indies, St. Helena, Cape of Good Hope, King George's Sound, Port Philip, Hobart Town, Hong Kong, and the Island of Perim in the Straits of Babelmandeb, barren and bare as it is, lies hard by Aden, and is capable of being fortified to great advantage, and commands, if ever a place commanded anything, the passage to India as effectually as the Suez Canal. There are many others which the gallant lecturer has pointed out here and elsewhere which may require fortification, and dockyards, and coaling stations, and so forth. Now comes the point, the personnel. You require for the defence of these distant positions peculiarly organised and trained soldiers, who are familiar with embarkation and disembarkation ; soldiers who are familiar with ships, and with ship life and ships' boats ; soldiers whose organization is such that they can be transferred hither and thither, from pillar to post, either to add to the strength of any particular point or for the purpose of making a descent upon any other particular point, as it may seem wise and good in the opinion of the commanding officer of the station at any moment, without confusion, difficulty, or delay ; soldiers who will be able to increase, if necessary, the ships' companies on foreign stations, who can fill up the gaps caused by death, disease and battle, who can relieve the ships of blue jackets required to man torpedo boats and vessels built upon foreign stations without difficulty, so keeping the ships' companies up to their full strength ; in fact, and in a word, the soldier best suited for these varied duties, and best adapted in every way to consolidate the military and naval elements of our fleet, and to make it a really comprehensive machine, and to

give it strength and completeness, our Royal Marine Corps used as a Colonial force ; you cannot do better than employ Marines for this purpose. You have an army in England, and you prefer not to have an offensive policy, but to fight only upon the defensive. The defensive policy only entails upon us an army for the purpose of holding India. In this very theatre, some time ago, a War Office authority informed us that there must always be in Great Britain 40,000 men at least, ready to be thrown into India at a moment's notice ; we have 63,000 men there already, and about 21,000 occupy some portions of the Colonies, whose places I have no doubt could be advantageously occupied by marines ; however, we won't interfere with that question, because they only occupy certain strategic points close home. The total strength of the army is 183,000 men, of whom we have therefore left 99,000 in Great Britain ; this gives us apparently a good strong nucleus for the army of England herself, formed as it is chiefly by volunteers and militia, and supported by the fleet ; showing more clearly than ever that you have no men to spare, that you must depend mainly upon your fleet, and that the defensive power consists almost entirely of maritime elements. My proposal then is this, that you do not alter the strength of the army by a single man as it stands at present, for it is scarcely equal now to your requirements, and if you commence any offensive operations it will be as much as ever your army can do to undertake them on an effective scale, and they will have to fight as they have heretofore fought, ten to one ; however, that won't alarm us. Therefore, I suggest, that you increase the Royal Marine Corps from 13,000 to upwards of 35,000 men ; the figure 35,000 was nearly reached once before by the Royal Marines, when it never took any part in the defence of our Colonies, but simply manned our ships, so that I am not stating anything original or out of the way. In the increase you take in hand you should bear in mind that the defence of the Colonies would form a new element altogether in the employment of marines, and reorganization would be necessary ; you would therefore attach to the present force an engineer branch, so that you would have your infantry, artillery and engineer branches of the Royal Marines, chiefly employed for the defence of the Colonies, and for manning ships of war on foreign stations :—this is my proposal, Sir, it is an inexpensive one, although the numbers may be startling ; you would not get troops that could do the same varied duties for the same money. You may try it as best you may, but in organising the Royal Marines upon such a principle as this, you will find that it is a far less expensive way of proceeding than by having troops from the army employed for the purpose under a separate administration from the navy, and because you are not fond of having armies abroad, surely there is everything further to say in favour of an increase of the Royal Marines under such altered circumstances. The Colonies, it must not be forgotten, will willingly share in the expense. There may be people here, Sir, who will perhaps say, " It is all very fine for you, a marine officer, to seek for pleasant Colonies and nice foreign stations, where you might recruit your health, and, perhaps, your shattered fortune, for we know that soldiers are not good financiers. Be that as it may to them, I will answer that we are proud of the mighty Empire that we serve, and desire the consolidation of her people ; and that, so long as Great Britain and her Colonies are one and all secure, so that wherever an Englishman plants his foot upon English soil he can feel that he is safe, it will be our proud privilege with others to appropriate to ourselves, with all due modesty, that famous old Roman passport, *Civis Romanus sum*.

Captain BEDFORD PIM, R.N., M.P. : It has been my good fortune to visit nearly all the places named by Captain Colomb in his most valuable paper, and especially the Pacific. I was stationed there six years, and I have since given great attention to opening out our communications with the distant Colonies in the Pacific. On this occasion I propose to confine my remarks entirely to the Pacific, because there I think I have had more experience than in any other parts mentioned by Captain Colomb. I am sorry to say Captain Colomb is strictly correct in his statement that the defences of Vancouver's Island are simply *nil*. I am indebted to an honourable gentleman, who has travelled a great deal, for the Report on the state of the Militia of the Dominion of Canada for the year 1875, by Mr. W. E. Vale, Minister of Militia and Defence, and as that gives the exact statement of the defences of Vancouver's Island, with your permission, I will read it :—“ At Victoria and Nanaimo there are “ two companies of infantry, clothed and equipped as rifles and in a very efficient

" state for any service. At New Westminster, on the Frazer River, there is a good company of infantry, and also a battery of artillery. It is suggested that a battery be mounted at McCanley's Point, on the promontory which projects between the harbours of Victoria and Esquimalt. In the absence of a ship of war, which occasionally occurs, there is not a gun, nor any kind of protection for the costly naval stores in the dockyard on the one side, nor the city of Victoria on the other. "A piratical cruiser of small force, entering by the Straits of Fuca, could destroy the whole place." The gallant lecturer has given us a still more depressing account, but I thought the official account would be best to read to the meeting. Captain Colomb tells us:—"By the last Inspector-General's Report, 1876, it appears but seven officers and sixty-nine men was the strength of the force at the last inspection, that the clothing was worn out, and that ammunition for the guns of the half-battery of artillery had only been supplied very recently, and the friction tubes, the only ones procurable, were entirely unsuited to the guns! There is no doubt about the efficiency of the personnel of this force, so far as it goes, and it is well it is so, for if ever attack should come, it will be the military forlorn hope of our empire of the sea in the North-east Pacific Ocean. No reinforcements, no stores, and no succour can reach that loyal land." Every word of this is strictly true; the island of Vancouver is absolutely defenceless. A small man-of-war in the Straits of Juan de Fuca could lay in ashes Victoria and Nanaimo, without possibly losing a man, and when this meeting reflects that at Vancouver's Island we have every atom of stores for our squadron in the North Pacific, very weak as that squadron is, only seven ships,—when they reflect that all our coal is drawn from that source, and that our ships are unfit to keep the sea under sail, and obliged to rely upon machinery, and therefore coals, for their movements, I think this meeting will very clearly understand the critical position in which we are placed, at this moment, in the North Pacific. So far as Vancouver's Island is concerned, I should not be doing my duty if I did not point out to this meeting that this state of affairs is scarcely creditable, to use a very mild expression. At this moment, lying in San Francisco Harbour, there are eleven Russian ships. Now nobody, I am quite sure, who has gone into action, as I have, with the Russians, can fail to feel that they are as gallant, brave and dashing a people as you would meet with anywhere. Nelson, our greatest authority, said, "Board a Frenchman, but out-maneuvre a Russian," showing what he thought of the bravery and pluck of the Russians. At this moment there are eleven ships of war, flying the imperial flag of Russia, at San Francisco Harbour. To my certain knowledge they are in the most splendid order. They have about 2,000 men on board, and a larger number of guns than we have in the very weak squadron we have in the Pacific, distributed from Chili right up to Esquimalt in Vancouver, so that they may be taken in detail with the greatest possible ease. Are those ships stationed in San Francisco for the purpose of attacking Turkish men-of-war, or merchant ships? I do not think any man in this meeting will tell me that those ships are stationed there for that purpose. Any one with half an eye must know exactly the purpose they are stationed there for, and I maintain energetic measures ought to be taken immediately to strengthen our force out there, and to place ourselves beyond the smallest chance of disaster in those seas. But how are we to do it? Since I left the station I have taken the greatest possible interest in the means of communication with our distant Colonies. Here is a book that I wrote in 1863; I will quote a few lines from it. What does the Duke of Newcastle, then Colonial Secretary, say with regard to our communications with Vancouver's Island, and that state of affairs exists at this moment, although perhaps in a worse form? He uses these words. The Duke of Newcastle, then Colonial Secretary, from his place in the House of Lords, last session (1862), said—"A short time back, when there was an apprehension of hostilities with the United States, he was unable to communicate with the Governor of British Columbia for the space of six weeks, there being a possible chance of any despatches sent via Panama falling into hostile hands." (*The Gate of the Pacific*, p. 5.) Now, Sir, you are a very great authority upon these matters. I know of no one who could more properly have been in the chair this day than General Collinson, and I want to ask you, supposing Russia was to declare war against us, in six hours from the time that war was declared, the commanding officer of those eleven ships in San Francisco would have the declaration of war in his hands; in four days very moderate

steaming, at eight knots an hour, he would be in Vancouver's Island ; but how long would it take before our ships were informed that war had broken out ? I will undertake to say not six hours but six weeks, and what would be the result ? Absolutely, Victoria, Esquimalt and Nanaimo and all our stores might be laid in ashes, and our ships taken in detail from Esquimalt right down to Valparaiso, the miserable seven ships that we have, not worthy of the name of ships, for the "Shah" is always out of order, and the "Opal" can hardly be moved, and four of the others are gun-boats. I will read you the list and the whereabouts of the ships to prove this :—

				Guns.	Men.
"Shah" (Peru) ..	..	..	..	26	602
"Amethyst" (Chili) ..	..	..	..	14	220
"Opal" (San Francisco) ..	..	..	..	14	232
"Fantome" (Sandwich Islands) ..	..	..	..	4	125
"Albatross" (Panama) ..	..	..	..	4	125
"Daring" (Esquimalt) ..	..	..	..	4	126
"Rocket" ..	..	..	..	4	72
				66	1,502

Total number of guns on the station 66, and men 1,502. The Russians have 75 guns and upwards of 2,000 men in effective ships that will keep the sea under sail as long as their provisions will last. I ask, is that a proper position for a great nation like this to be placed in ? I am bound to state, and I hope the Chairman will not say I am using strong language, that it is a disgraceful position for us to be in. Every one of us is proud of our Colonists ; they are true Englishmen, and yet we are incurring the fearful responsibility of allowing those men to be slaughtered, really mown down, without taking the smallest trouble in the world to afford them assistance. We cannot even let them know in Vancouver's Island till they are shot down, that war has been declared. That is a terrible state of affairs. I think I have said quite enough to show, so far as the defence of Vancouver's Island is concerned, we really are in a most deplorable condition. Now, I am going to ask the attention of every man present on another point altogether. At the commencement of this century this great country of ours had sufficient area cultivated to maintain its people in food ; but since then the population has more than doubled, and the fact that our insular position at the commencement of the century was our very greatest safeguard, is now quite reversed. The insular position of England is its greatest danger. There is no question that England could be besieged as easily as Metz or Paris, and you could besiege England with perfect ease, not in the English Channel but from Vancouver's Island. Is this meeting aware that from Vancouver's Island is now commencing the sailing of an enormous fleet of ships ? They begin to leave about the last day in June, and steam homewards until October, bringing to this country six million quarters of grain, without which this nation cannot subsist. Is the meeting aware of this fact, that more than half of our food comes in from abroad, and that if there was an enormous rise in provisions in this country the very institutions we hold most dear would be imperilled ? How could you expect our proletariat to behave as they did in the Lancashire famine, when they have every trade connected with shipping stopped, not alone cotton, and nothing at all to eat ? The whole aspect of affairs is most dangerous. We have not a single ship told off to convoy that grain to us, and yet six million quarters will shortly commence sailing from San Francisco, bringing us the grain without which we positively cannot subsist, for we never, in this country, have more than six weeks' supply of provisions at any one given time. That is a consideration I am very anxious to impress upon this meeting. I assure you some of our very best statesmen have hardly awoke to the fact that that is the case, and they still persist in the belief that the insular position of England is its greatest safety. Nothing could be more fallacious ; it is its greatest possible danger. If that is so, surely something ought to be done to awaken our Government to a sense of the great danger we are in. I for one consider my gallant friend Captain Colomb has done noble service with this magnificent paper of his. Many papers I have heard, and much as I have seen of this sort of thing, I do not think I ever listened to a paper

that contained such a mass of valuable information. But surely we should not allow the great facts divulged in that paper to fall to the ground without taking some steps to make them known. This Institution is a first-class institution. In this Institution some of the best plans and projects are put before the world that you can possibly conceive, on naval and military matters. Captain Colomb has done great service in bringing this before us now. I am entirely in the hands of the Chairman, but I am simply going to suggest that he should be requested by this meeting to transmit to the Minister for War, to the First Lord of the Admiralty, and to the Colonial Secretary, a copy of the paper by Captain Colomb, entitled, "Russian Development and our Naval and Military Position in the North Pacific," and at the same time to call the attention of those ministers to the defenceless condition of Vancouver's Island and Hong Kong, to the weakness of the squadron in the China Seas and the Pacific, and to the totally unprotected state of our merchant ships, now about to sail with a grain supply of six million quarters for home consumption. I simply make the suggestion, and, if it is followed, I think the Chairman would be adding to the many great services he has already rendered to his country.

THE CHAIRMAN: I do not think it is in the power of a meeting like this to take such a strong step as to make any communication, or enter into any direct correspondence with the Government at all, because we are only a sort of subsidiary meeting of a great Institution. This is not a general meeting of the whole Institution, in which they act as a body, it is only an occasional meeting of it. We could not let this go any further than the Council of this Institution; we must leave it to them as the representatives of the Institution, in default of any general meeting of members, to act as they think proper in the matter. I could express that it is the general opinion of this meeting that something should be done, and leave it to the Council to act as they think proper. ("Hear, hear.")

Colonel RHODES: The information I am about to furnish is from Consul the Honourable Henry Rhodes, who is the Consul of His Majesty the King of Sweden and Norway, and also Consul for His Majesty the King of the Hawaiian Islands, and who resides at Victoria, Vancouver's Island. It was only on Thursday last that I happened to meet him in London, at the hotel where I am stopping, and his name being the same as my own, he sought my acquaintance. I mentioned to him about the meeting taking place in this Institution, and asked whether he would not attend to give any information that he could, in respect to Vancouver's Island. He has kindly attended to-day, and will have the pleasure of giving you some particulars on this subject. He has also furnished me with notes, from which I am able to give you the following information. He has been a resident at Victoria since the commencement of 1859, and has also been about thirty-two years living on the Pacific. In respect to Captain Colomb's lecture on "Russian Development, and our Naval and Military Position in the North Pacific," and the total defencelessness of the imperial and provincial interests of the Dominion of Canada, Mr. Rhodes recommends that an efficient naval and military force should be stationed at Esquimalt and Victoria. At the present moment there is a naval station and dockyard belonging to the Crown, in which large supplies of naval stores of all descriptions are held, including large coal depots and powder magazines. The coal is obtained from Departure Bay (Nanaimo), about 80 miles up the coast, where coal mines abound of excellent quality for steam purposes. With regard to the coal, I believe Mr. Consul Rhodes will be able to afford some very valuable information. During the last two or three years the visits of vessels of war have been very infrequent, and during the last two or three months the naval force has been principally represented by the steam gun-boat "Rocket," manned with about seventy men. This gun-boat is small, and very slow, and took nearly twenty days to accomplish the passage from San Francisco to Victoria—a distance of 750 miles, which distance is frequently made by the American mail-boats in from 68 to 96 hours, or three or four days. I met a gentleman this morning, who has only to-day arrived from Victoria, and spoke to him about this discussion, but am sorry that he is not able to attend here to give any information. I asked him one or two questions with respect to the naval force that was there, and especially with respect to the gun-boat "Rocket." He says that the "Rocket" has two guns, one 64-pounder and one 100-pounder, or a 7-inch bore. The gun-boat has only seventy men all told, and they are very closely packed. He also says that the "Rocket" can

steam about eight knots an hour, but generally only three. It is supplied with the old engines. It is about seven years old, and is one of the worst boats in the Navy. He says also she cannot steam against a strong wind, as her voyage from San Francisco proves. Mr. Consul Rhodes informed me that the existing naval dockyard, situated at the entrance of Esquimalt Harbour, is quite open to the Straits of Saint Juan de Fuca, which separates the English from the American coast, distant about fifteen miles. In the absence of the "Rocket," when visiting the other parts of the province, which frequently occurs, the imperial naval dépôt, with all its stores and other valuable property, guns, shot and shells, &c., are left totally without any protection, and is at any time liable to destruction by any filibustering or Fenian expedition, of which several have been reported during last summer as organising in San Francisco. There is no battery or other fortifications to protect this dockyard and its naval stores. Within a few miles of Esquimalt, nature has provided a magnificent site for a naval station and dockyard, which at small expense could be rendered completely secure from any foreign naval attack. This harbour, or inlet, is called Sooke Harbour, and is situated about twenty miles nearer the Pacific Ocean than Esquimalt. This inlet consists of two harbours; the outer one is about two miles in length, and one mile in width, the entrance to which is very narrow, and the surrounding land affords every facility for its complete protection. The land on the eastern side of this harbour is elevated, and thus completely screens from view the second, or inner harbour, which latter is the one recommended by Mr. Rhodes for the new naval station. This inner harbour is about three miles in length by two in width, and has a depth of from eight to twelve fathoms. The distance from this inner harbour to the Straits of Saint Juan de Fuca is about four miles. It is also surrounded by high land and mountains. The Sooke River, which is navigable for about two miles, by canoes only, runs into the outer harbour, near the entrance to the inner harbour, causing a deposit of sand in the channel, which could be easily dredged out. Deposits of coal are known to exist on the west side of the outer harbour, it having been found out-cropping on one of the small streams running into this harbour. In addition to this it has been proved by boring by the owners of the land, who are experienced coal miners, they having passed through two seams, and were approaching a third seam, when their bore was unfortunately lost or filled up by a heavy gale rolling the shingle into it, it having been commenced too near the shore. Since that time the owners have not been in a position to re bore on their estate. Iron ore of good quality also exists in this same district. Timber of excellent quality and size is plentiful on the shores of both harbours. There is a good wagon road from both harbours to Esquimalt and Victoria, from 25 to 18 miles respectively. Those are the notes that I took down from Mr. Consul Rhodes. Never having been at Vancouver's Island, I am not personally able to give any further information, but I think we were very fortunate in meeting with Mr. Consul Rhodes, who has resided there so long, and who will be able to furnish further particulars with respect to coal mines that I cannot give; also with regard to the naval force there. He also has some observations to offer with regard to the communication between the Dominion of Canada and Vancouver's Island.

Mr. Consul RHODES: With your permission I will read the brief minutes I have drawn up at Captain Colomb's request. It is principally in reference to the railroad. The construction of the Canadian Pacific Railroad, which was the inducement offered the Colony of British Columbia to enter the Dominion of Canada as a province, has not yet been commenced, although several years have elapsed since the date fixed for its commencement by the treaty of union made between the English Government on the one part, the Canadian Government on the second part, and the Government of the then Colony of British Columbia of the third part. This treaty was made in 1870 or 1871, and it was understood in the Colony that the English Government, by arranging and becoming a party to this treaty, were equally bound with the Canadian Government to carry out the terms agreed upon between them and the Colonists in question. It seems to me strange and inconsistent of the British Government to have allowed the provisions of the treaty of union, to which they are a party, to remain so long unfulfilled. Had this treaty been made with a foreign government, instead of with the province of British Columbia, the British Government would no doubt have strictly carried out the provisions of

such treaty. From advices received from the province during my stay in England, I learn that the people of British Columbia are determined to demand separation from the Dominion of Canada in the event of the construction of the railway being much longer delayed. This determination, if carried out, might prove a misfortune to England, as it would place the province in the position it was in when General Harney made his memorable descent upon San Juan Island, which was then, and had been for years, in the peaceable possession of England, and the result of which has been to plant American guns within reach of the Vancouver shore, and which guns command the channel from the southern to the other portions of the province. What has once happened may occur again; and although the historical pig that was put forward as the justification for this outrage must now be dead, excuses will be found whenever another American general may think it prudent to court popularity by such a measure. The Americans know the value of British Columbia, and are most anxious to acquire possession of it by annexation to their adjoining territory; and their newspapers have for years advocated the desirability of it; and it was only in furtherance of this object that they purchased Alaska from the Russians; and every action taken by the Americans upon the Pacific coast seems to have for its object the crippling of the trade of British Columbia, and thus drawing the Colonists to desire annexation as a remedy for their troubles. Amongst other steps taken is their refusal to allow us to participate in the benefits to be derived from the Treaty of Washington, on the ground that our union with Canada was not complete at the time of the negotiation of that treaty. The people of British Columbia are very loyal, and desire to remain closely united with England; but they feel that their interests have been so very cruelly dealt with, that there is no knowing how they might act if once they found themselves free to act according to their interests. The Colonists who live there, and are familiar with the state of the country, its position, and surroundings, are satisfied that this railway would be of immense importance to the English Government, and they regard it much more as an Imperial question than a Canadian one. It would open a magnificent country for settlement to the surplus population of Great Britain, who would upon their arrival there find themselves part of a population thoroughly English in their thoughts and ways, and bound to England by the strongest ties.

The American Pacific Railway passes through a desert of more than a thousand miles in length, while the English Railway would pass through a magnificent country known as the "Fertile Belt," capable of raising a food supply sufficient for Great Britain. In the Red River Settlement, which is part of this Fertile Belt, and which I believe was originally founded by the Hudson's Bay Company, wheat has been grown for the past thirty years without manuring the land, the crops are very heavy to the acre; and the land, which is described as black alluvial soil of great depth, seems practically inexhaustible. At present, British Columbia can only be reached by a railway journey of about three thousand miles through American territory, and then by a sea voyage of seven hundred and fifty miles from San Francisco. The mails for Australia also have to be carried the same distance through American territory to San Francisco; but this railway would open communication with British Columbia, and consequently with Australia, India, China and Japan, entirely on British territory and through a most healthy region. This railway would open up direct communication with the whole of British North America and China, India, Japan, and Australia, and the large supplies of Eastern produce required by Canada would go by this route, and thus help to develop trade in a community who draw their manufactures almost exclusively from England, instead of, as at present, going through and helping to build up American interests, whose commercial policy and protective tariff are in direct antagonism to the interests of British manufacturers. The railway will I think have to be carried across from the mainland of British Columbia to Vancouver Island, and thus down to Esquimalt, as originally decided by the Canadian Government, and if a strong naval station should be established in Sooke Harbour, as suggested, it could be readily connected with it, as the line down to Esquimalt would run very close to the Sooke district. It appears to me that any point on the mainland, the approach to which is commanded by the American fortifications upon San Juan Island, is totally unfit for such an important work as the terminus of the railway in question. I have been on the Pacific for thirty years, and

it has happened to but few men to see such a marvellous development of a country from a mere wilderness, as I have seen in that part of the world. When first I went out there, I think there were not five hundred Europeans or Americans between Cape St. Lucas and the North Pole, and now the American States on the Pacific number their populations by hundreds of thousands, and have such cities as San Francisco (which is even now one of the most important maritime ports in the world), Sacramento, Portland, Salem, Los Angeles, Monterey, Stockton, and very many other towns of importance, while the productions and exports of California and Oregon are vast and varied. They have heavily fortified harbours, lighthouses and arsenals, and with their own railroad connecting them with their Eastern States, are ready for any emergency at any moment. They have also secured, by special treaty with the Sandwich Islands, a coaling port or station there; these islands are in mid ocean, and in the direct route to Australia, and India, and China; this is a very important point, and, I think, concerns England very much. They have also connected Puget Sound with Columbia River by railway, so that in the event of war, troops and war material wanted in that part would be independent of the passage up the Straits of San Juan de Fuca.

The Russians have not been idle during this time, and are developing their naval and military forces in that remote and comparatively unknown portion of the world, as is evidenced by the fleet lately sent from the Amoor River to await events at San Francisco. They also have direct telegraphic communication between their Pacific possessions and their own government, upon their own soil. England, however, seems the only power interested that is not keeping pace with the march of events, and yet I think, with her enormous interests in India, China, Australia and Japan, she has much more at stake in the security of that section than either the United States or Russia. Vancouver Island has the best coal for naval purposes in the Pacific, and at the present time, while political affairs are in such a disturbed state, and with a Russian fleet awaiting telegraphic orders from St. Petersburgh at San Francisco, she has but one very small gun-boat to protect her most important, and in fact, *only* coaling port in the North Pacific, and when that gun-boat is absent visiting distant portions of the province, which of course frequently happens, they are without defence of any kind, and the coaling port and the naval station would alike be at the mercy even of a mob. It is true we have some Canadian militia organisation in British Columbia, but how effective that is may be gathered from a fact mentioned to me a few days since in London, by the Honourable Joseph W. Trutch, our late Lieutenant-Governor, namely, that when, as the representative of Her Majesty, he went to open or prorogue the Provincial Parliament, his guard of honour never exceeded fourteen men, rank and file; and as these were events well known and prepared for beforehand, I presume all were got together that were available at the time. England has no means of telegraphing to her naval authorities in British Columbia except by way of the American telegraphic lines.

The CHAIRMAN: May I ask if you can tell us something specific about the coal in Vancouver's Island, and the use that is made of it?

Mr. Consul RHODES: I think last year there were 110,000 tons exported from Nanaimo, and coal is known to exist on other parts of the island. It has been proved, but not many mines are worked. There is one up at Bayne Sound. Coal also has been found to the north, on Queen Charlotte's Inlet; that is anthracite coal of excellent quality.

The CHAIRMAN: What is the character of the coal in Vancouver?

Mr. Consul RHODES: What they call brown coal; it is not anthracite, but it is very hard. There are different characters. The kind best adapted for steam purposes, and that is used by the Navy exclusively, is hard-looking, dull coal; but it is very good coal indeed; and I think, in comparison with the American coal found on the main land near there, it is worth about 25 per cent. more, weight for weight; that is, the same weight of Departure Bay coal will do 25 per cent. more work than American coal.

The CHAIRMAN: And about its price, compared to English coal at San Francisco?

Mr. Consul RHODES: Well, labour is so very high in the Colony, that coal is rather dear—5 dollars a ton at the mine—last year it was $5\frac{1}{2}$. There are some coals that are a little cheaper, about $4\frac{1}{2}$.

The CHAIRMAN: There is less difficulty in getting at it?

Mr. Consul RHODES: No, it is a different seam, softer and more easily worked. The coal at Departure Bay is really a magnificent coal, and, of course, doing more work, you can stow more of it in bulk, it will go further. There is coal at the further end of the island, Quetsino Sound. The country is also full of iron. There is one island supposed to be half iron.

The CHAIRMAN: Not worked yet?

Mr. Consul RHODES: No; there are very few works carried on there at all.

Captain FIELD, R.N.: The question of a railway through Canada seems to me to be an Imperial question, and therefore we in this theatre are not competent to deal with it. I shall now allude to the remarks that fell from the honourable Member for Gravesend. It is right that his views should not go unchallenged, although they come from a Member of the Legislature. Captain Bedford Pim tells this meeting gravely, as a Member of Parliament, that he looks upon our insular position as a source of weakness and not of strength. Now, I state that such an opinion is in direct conflict with the opinions of one of the greatest statesmen England ever possessed—an ex-Prime Minister of this country—who wrote a very powerful article in the *Quarterly Review*, in which he told us that England's source of strength was in a great measure due to that "silver streak." I do not say that I agree altogether with that view; but certainly I go a very great way indeed in support of that opinion; for if it had not been for the "silver streak" we should have been engaged in a great many very severe continental struggles from which we have been saved; and I am astonished that a British Member of Parliament can rise up, with the grand history of this great country before him, as the greatest maritime power in the world, and tell this company of British officers around us, that our insular position is a source of weakness and not of strength. I hope he will propagate those opinions in the House of Commons, when, I am sure, he will be much more efficiently answered than he has been to-day. I join heartily in all the congratulations which have been given to the lecturer, for no one more richly deserves them. I have listened to the lecture with very great pleasure. It furnishes us with a great deal of important historical information; but, after saying this much, I will not say I am sorry, but I am glad, I do not agree with his conclusions. Further, I do not agree with many of the remarks that have been uttered in this meeting; and, as we are a company of British Officers, I hope that, though I differ in opinion from a great many of my friends, I shall be listened to with patience. This is not a public meeting; we are not a mob; and, therefore, I shall not be howled or yelled down; but I hope I shall be allowed to say a few things, even though they may be in opposition to the views that have been expressed, and to the views which I fear are held by a majority of my brother officers. I could not help perceiving the current of feeling running through the whole of the lecture. I won't say of alarm—but of what I may call watchful jealousy—with reference to a great power like Russia. Captain Colomb lays stress upon important points in our Colonial possessions being fortified as strategic bases, and says that those points ought to be made almost impregnable. He goes so far as to say we ought to have Imperial dockyards at different points in our Colonial Empire. Now it seems to me that Russian statesmen, sitting in their private libraries, and with the gallant officer's lecture before them, might really utter almost these same opinions, and apply them to England, and to the power of England, as displayed in her Colonies. Russia might very properly say: "A great naval power has, after centuries of persistent efforts, established itself in "Australia. The coast line, the interior, and the communication with the interior, "are all capable of developing maritime strength. The naval and military development will be, at some future time, out of proportion to the commercial and industrial "progress of that region." The lecturer goes on to say: "China and Japan are no "longer elements which can be entirely ignored." I say that those opinions might be equally well expressed by Russian statesmen when considering the power of England as regards her Colonial Empire. I was glad when one speaker got up and stated that he was pleased to see that there was a development of naval power on the part of Japan and China. I join heartily in that expression, because I think a country like China and Japan does well to extend and increase its naval force, so that it may not be at the mercy of a great power, not far distant from its own borders,

like Russia. Then we must bear in mind that these two powers owe what little naval force they at present possess mainly to the assistance of English officers, who have been sent out, with the approval of our Government, to assist in developing that force. The gallant lecturer, however, does not raise that as a scare, but he goes on and points out a source of weakness appertaining to the position of British Columbia. He says: "Taking into consideration the distribution of coal, Vancouver's Island will certainly be the first point of attack. If it is to be left to the protection of a 'sea-going fleet, the line to Australia must be kept open till reinforcements from 'England can struggle round the Horn.' I state broadly, it is an utter impossibility that we can pretend to defend every isolated position in our Colonial Empire. The true defence of those outlying stations lies in this, that whoever attacks them attacks the heart of England, and the battle for the defence of those outlying positions will not be fought on their coasts, but in the British Channel, the Mediterranean, or on the broad Atlantic. ('No! no!')". I say broadly, Yes. Then you must go in, if you please, to defend the frontier line of Canada. You must ask the British Parliament to sanction the expenditure of millions, to erect forts along the Canadian frontier; and I think you may imagine how they would laugh at the gentleman who should rise in his place to offer such an opinion. You cannot attempt to defend every isolated position. I state that broadly; it is an impossibility; and, if you think it can be done, and should be done, you may try your powers; but, it will be like beating the air, for this country never will sanction such a policy—the taxpayers would not assent to it. But they would agree if Government would come down and ask them to strengthen your fleets on foreign stations, because that is a proper development of your naval power; they will agree to an increase in your Channel or your Mediterranean fleet, or your fleets at outlying stations; but they never will agree to fortify strong positions so as to make them impregnable, nor to erect forts to defend the frontier of Canada, nor to spend millions of money in forming dockyards at outlying stations in our Colonial Empire; but they will agree, no doubt, to expend sufficient money to render certain places, like Vancouver's Island or Hong Kong, safe from a *coup de main*, or from a buccaneering expedition. But to attempt to defend them by making them impregnable against the attack of a fleet is a simple impossibility. I join with those who regret that our Pacific Squadron should be so weak. I think that is a terrible mistake. I think it was a great mistake to send out a vessel like the "Shah," in these times, to relieve a ship like the "Resistance," on that station; but the Admiralty have done it in their wisdom, and they will be responsible to the country for their action. Many of the questions that have been advanced by the lecturer are imperial questions, and can only be discussed and decided by Parliament; and I feel satisfied that Parliament would never agree to sanction a large expenditure of money for the establishment of colonial dockyards. I thoroughly agree with Mr. Arthur Kinnaird in thinking that a great Colony like Australia might very properly be invited to assist in strengthening a position like Sydney, or in the formation of something like a dockyard there, so that our vessels on that, or any other station, might go there for repairs. I think that positions like Hong Kong, Vancouver's Island, and other outlying stations, cannot be defended properly at their own particular points; but their true defence is this, that whoever touches those stations, or attempts to send an expedition there will be attacking England. Of course they never will do it, except in war with England, and the true defence of such stations is the fleet. Does it not astonish you, in considering this question, that we Englishmen, with all our maritime power, should be invited to indulge in these fears about the power of Russia, while America knows no such fears? Surely she has more reason to fear the attack of a Russian squadron than we have; and yet we hear of no such violent scares on the part of America. I say, a free country like England has no cause to fear the power of a country like Russia. I protest against such fears; and I think that they ought not to find a place in our minds. Let us by all means do what is right on the part of a great nation; let us strengthen our fleets on our distant stations; but do not let us lead the country to think that we are to be perpetually watching, like a Red Indian, ready to fly at the throat of another power, just because she, in the exercise of her sovereign rights, chooses to extend her dominion, and to have a naval force, which she has a perfect right to do, in those regions. I am very glad to have listened to the lecture, but I do not agree with all its conclusions.

Mr. YOUNG: Captain Field has objected to the remark made, that our insular position is a disadvantage, and he has quoted against them the opinion of a certain ex-Prime Minister, who, he said, was a very great man. Now, I think, in support of my view of the case, I can bring forward the views of another Prime Minister, and I will leave the public to judge which was the greater man of the two. Lord Palmerston, who I believe was somebody, expressed his opinion, in the year 1858, that steam had bridged the channel, and that our insular position was now no longer our safeguard. Our danger is this, and it is a very astonishing thing to me to notice how little attention is paid to the point. I do not think as Englishmen, take us physically, man for man, we are a bit worse than we were, and I do not think that we are likely to be if we stand up and use the common sense that God has given us. But then what have we been doing? Take our Colonies—have we made them an integral portion of our empire? Have we worked them in such a way that in the hour of need they will become portions of us? No. What have we done? We have got this infernal principle of trade, buying in the cheapest and selling in the dearest market. That is what we have gone upon; get it, honestly if you can, but get it! What is the consequence? We are now dependent upon the good will of other nations to supply us with food as long as it suits their purposes to do it. We are told not to be watching Russia. But why should we do it at a cost to ourselves, if we can prevent their having the opportunity of putting us to this expense, loss of life and trouble, that they are continually doing? Why it is because we are not ready. The Dutchman had a beautiful anchor; but when he was caught in a gale of wind, where was it? It was at home, and the ship was lost; the possession of the anchor was of no use, because it was not ready when it was wanted. Let us take care that we are not in the same position.

Admiral Lord DUNSANY: I do not wish to enter on a discussion of large questions of imperial policy, and I think that there have been some rather questionable theories propounded about it, especially by the honourable and gallant member opposite, and upon those points I should like to say a few words. Of course it is a very telling thing if you say, on any occasion, on some important station where we have got great interests, the Russians have a very large squadron and we have a very small and insufficient squadron; that appears to carry at once condemnation to the Ministry of the day, and hardly to admit of reply. But you must recollect that it happens to ourselves, for instance, every day in the year, that we send a flying squadron to this place or that place, and wherever a flying squadron makes its appearance there we have an overwhelming superiority of force. Now, with respect to these points, do you imagine it would be just for a Frenchman to impugn the conduct of a French Minister because an English flying squadron had appeared, we will say, in the Pacific, and had turned the balance immensely against the French squadron? I take it there are certain permanent arrangements made, with regard to the distribution of our navy on foreign stations, which have regard, not to the flying squadron of this power or of that, but to the usual distribution of force among the other naval powers. No doubt when we received information that there was a powerful Russian squadron at San Francisco, we might have sent out a still more powerful squadron or sufficiently powerful squadron to watch it. What would have happened? I presume the Russian squadron, if they have any particular designs against us, would have disappeared some foggy night and have gone, how shall we say, where? Let us suppose, for instance, that they had taken up a cruising ground exactly on the line of our Chinese, East Indian, Australian, and North American trade, or West Indian trade; should we have been so very much the better for that? If I am to be told at a certain point we are outnumbered by the Russians, I must say, for my own part, I would rather hear that they were at Vancouver Island, than that they were either in the chops of the Channel, or cruising in the West Indies, or in any other places where they might be. The enormous extent of our Colonial territories really makes it a matter of absolute arithmetical necessity, that if we are strong on one point we must be comparatively weak on another point. If we distributed our ships equally over all our possessions we should be weak everywhere; is not it better to be weak somewhere than to be weak everywhere? Again, it has been said, and with great force and plausibility, that we have valuable and rising possessions out in that quarter of the globe, and among other very valuable possessions, in a military and naval point

of view, that we have coal, and it has been suggested that we ought to fortify those points in order that we might be able to hold them against all comers. That policy is not quite beyond question. It must be remembered that our frontier is as five to one to the frontier of Imperial Rome when she was at the height of her power. Our frontier—why it is almost incalculable! Take the frontier of Canada, and I must say I rather agree with one of the last speakers, that the defence of the frontier of Canada against a nation that now outnumbers us in population, would be rather a difficult task. I cannot quite imagine the military arrangements which the Horse Guards would be called upon to make in order to defend, say 4,000 miles of frontier, against a powerful country which had, not very long ago, very nearly two millions in armies on the two sides—the United States; I do not quite see that that is practicable. With regard to the outlying stations, say Victoria or Esquimalt, it is conceivable that we might build very powerful forts there that would be more than enough to resist any Russian squadron; but there is another question, we are rather perhaps creating a difficulty with our powerful neighbour there. I am not at all sure that it would be the wisest policy to make a military station of what may be a very valuable commercial possession. As a commercial possession, while we are at peace, we shall hold it, if we go to war no doubt we should lose it; but at the same time there would be far more probability of our recovering it again when peace came about, so far as the United States are concerned, than if we were to establish a thorn in their side; a military position not strong enough to defend itself, but quite strong enough to provoke a great deal of jealousy and legitimate fear on their part. I think the honourable and gallant officer who spoke about the 6,000,000 of quarters expected from Vancouver's Island is under some misapprehension.

Captain BEDFORD PIM: From America, not from Vancouver's; 24,000,000 of quarters was the exact amount sent last year from America to England.

Lord DUNSDANY: From both coasts?

Captain BEDFORD PIM: From both sides. The Russians have a squadron at New York precisely the same as at San Francisco.

Admiral of the Fleet Sir HENRY CODRINGTON, K.C.B.: I share, Sir, as warmly as speakers who have preceeded me in admiration of this paper, and in a feeling of deep interest in the subjects raised by it. I need not go into them all; but with respect to remarks made by some gentlemen about having a strong fleet in the Pacific, and our Empire depending entirely upon our fleet, we must remember always that a fleet is a very fine thing, a very efficient thing indeed; but for success in its operations, it requires a base. Here we are. I am looking at that Vancouver's Island on the map before us, and I look at the distance that that is from England, and I say that, in the event of sudden hostilities, it is utterly impossible that anything we could send round there would have any material influence on a war that has just been suddenly declared by telegrams to us. We are at present in the situation, it appears to me, of being simply swept out of the Pacific; and we must remember that, supposing we are swept out of the Pacific, and an enemy has got possession of all the stores and means of recruiting by coal and other means that there are in Vancouver's Island, our only base of operations, he has shut us out of it entirely; and if we were to send a most powerful squadron round to try and recover our supremacy in the Pacific, on what should we depend? We should be without any base, and we should be at the very greatest disadvantage in trying to recover that which, I must say, I think we should never be at the risk of losing. I am not an advocate for wasting our forces at a number of points which perhaps might not produce so much effect in a general war; but I do think an important point, such as that on which we really must depend for anything in the Pacific, ought never to be abandoned by us in any way. I am coming to another point, on which I think I am a little at issue with the honourable Member for Gravesend, which is this: he was advocating that this meeting should express an opinion through you to be laid before the Council. I do not think that can be the province of a meeting such as this. We must always remember that here we, lady and gentleman visitors, besides members, who are composing this meeting, are a meeting at the United Service Institution, but we are not a meeting of the United Service Institution; they are two very distinct things. The United Service Institution, when it meets here, is composed entirely and solely of its members, and gives its instructions to its Council, and the Council

acts for the United Service Institution on certain well-defined rules which regulate its proceedings. I do not find anything in the constitution of this Institution that would authorise a meeting such as this to express an opinion which is to be conveyed to the Council for the purpose of the Council conveying it to the Government. I think that this meeting would be stepping out of its province entirely if it did anything of that sort. I conceive that the Chairman—knowing the value of this paper, and no one can set a higher value on it than I do—may well, in his capacity as Chairman now and member of the Institution, draw the attention of the Council to it; and I am sure the Council is perfectly ready to act in the interests of the two services, and of the country also, at any moment in trying to impress its opinions on the Government in its own quiet way.

Mr. BIDDLE: There was an observation made by a gentleman opposite, with regard to the jealousy we might cause the United States by building forts and trying to provide for the defence of our channels in Vancouver's Island and British Columbia. If we were to study the United States in the matter, I think we might as well clear out of Canada and Vancouver's Island and all the rest altogether, because the United States regard with considerable jealousy our sojourn there at all. I have been four years in the States, and can assure the meeting that what I state is a fact.

The CHAIRMAN: We cannot go into a question of feeling.

Mr. BIDDLE: I beg pardon; but that is what the gentleman opposite referred to. But speaking of the jealousy our building forts would occasion to the Americans, such precautions would occasion no more jealousy than there is now in fact. They regard it as very silly and absurd upon our part not to have done so already. Their newspapers are full of articles upon the apathy with which we regard our splendid position in Vancouver's Island.

Colonel ALCOCK: The subject of America has been brought up two or three times, and once on a former occasion by the distinguished Chairman himself, when he quoted the opinion of an American upon the number of the English-speaking races. It is very clear that both America and Russia are concerned in this question of our food supply. One gentleman said it was absurd to suppose that Russia and America could have any sympathy and act together. The question of the feeling in America may, of course, be seen from two different points of view, and it might perhaps be well to bring it before the meeting in the shape in which it happens to have been expressed in print, and by, as I suppose, an American statesman, because I think we ought to have both sides of the question. It is only fair to men of great distinction to hear what they have to say upon the subject. His observations are as follows:—"Any real sympathy of Russia with the United States would be a natural "and political paradox; if Russia should be eventually successful in wresting from "England her Eastern Empire, it would be one of the greatest misfortunes that "could befall the American people. It would leave us (the Americans) almost "alone among the great Powers to fight the moral, religious, and political battles "which are still before our race." These are the words of an American. Further on he says: "If our sympathies shall lie with Russia against England in the final "struggle, the unity of the English-speaking world will be a forgotten idea of past "generations, and Great Britain and the United States will be as hopelessly foreign "to each other as are France and Germany to-day." Those are the words of a very thoughtful American; and as they express a very kind and elevated feeling, I do think I am quite right in having asked the meeting to allow me to bring them before it, because the question should be fairly stated and seen equally from every point of view. If the Americans as a nation were untrue to their race, were untrue to the great position that they hold with respect to civilisation, if having common ancestry and common interests with ourselves, the sentiments of the whole community does not take the impress of the most enlightened class, but in the event of war they take part against us, it would bring to many now quiet and prosperous places near and far those cruel and destructive necessities of war which would produce ill-will, if they did not foment a smouldering feeling of hostility, to burst at any moment into a flaming desire for revenge.

Captain COLOMB: I think I shall best interpret the wishes of the meeting by making my remarks very short, and indeed in this discussion most of the speakers have

answered each other. I think it has been a valuable one, because some very important points with regard to the Russian seaboard have been settled; you may remember I called attention to the great difficulty there was in arriving at any conclusion as to how long the ports of Russian seaboard were open, and I think Captain Bridge settled that question completely. With regard to the depth of the water of the Amoor, Mr. Champion's statement about the "Dwina" having passed up there must be received with a certain amount of caution, for this reason, that the Russians removed all the heavy material from those vessels that were in Castries Bay before they attempted to take them to the north. I stated in the paper that the depth of the Amoor was stated by Captain Bax to be eight and a-half feet, and difficult, but at the same time the North Pacific Directory stated it to be twelve feet. But the "Dwina" cannot be taken as proving any particular draught because she was sent lightened, as all these ships were.

Mr. CHAMPION: But a long way over twelve feet draught of water.

Captain COLOMB: She was lightened, and in one case I know that there were empty casks used. I merely wish to say, with regard to Captain Bedford Pim's remarks with reference to my statement, as to the 63 men and the tubes entirely unsuited to the guns, any one may find that statement in the library of this Institution, in the official report of the Inspector-General of Militia of Canada that has just been issued. And with regard to the "Shah" and "Opal" being out of repair, it is a very serious weakening of our fleet, two out of seven; and I think that shows the necessity of this empire providing the means of effectively repairing our ships on the other side of the world. I am sure this Institution must be greatly indebted to Mr. Consul Rhodes for his kindness in giving us such valuable information. Because some of these places are at present weak, we are too apt to regard them with an idea that we need not pay much attention to them till they are strong; but I believe a little care and attention in their youth will ultimately make the whole empire strong. And in speaking as I have done of Vancouver's Island, I have worked at it to the best of my ability entirely in an imperial sense, and when Captain Field puts aside the railway as an imperial question, and not to be discussed, I say that it is a question that within certain limits might be very well discussed in this Institution, because it is an imperial question, and so is war an imperial question. I think, after what Sir Henry Codrington has said with reference to the importance of that naval base, and the consequences of our losing it, that the railway across Canada is one vitally concerning the whole empire, and for this reason it is necessary we should hold Vancouver's Island. There are naval developments and military developments in Russia and in the United States. We cannot shut our eyes to that fact, and we cannot shut our eyes to the fact that the only means of communication we have is round the ocean, and where we see a power of concentration by other Powers possible to be brought against a point of imperial importance to us, I think any question that tends to enable us to communicate with safety, security and celerity, is an imperial question, and one which should be by no means overlooked. With regard to the naval bases, I will not take up your time by saying anything further. I should prefer leaving it to our able Chairman.

In conclusion, I would say this, that after two days' discussion we have elicited some very important facts, and there can be no doubt about it that we all agree in the necessity for defending the Empire in the whole; the only point of difference is, how it is to be done. Some people say, have no naval bases, no fortifications, leave it all to your fleet; others take different views. I think the question of imperial defences, considering all the various scattered portions of our territory, the different circumstances in which they are placed, their want of inhabitants, and other matters connected with them—for instance, in the West Indies the Coolies, at Hong Kong the Chinese—this is the most complicated question; but even getting rid of what may appear to be political questions, this is a great naval and military prob'lem, and while we are all anxious to defend the Empire, we have never had the subject considered as a whole. I do trust this discussion will produce some ultimate good result. We had a Defence Commission in 1859, which resulted in the fortification and safety of the bases of our fleets at home. I do not think this question of imperial defence will ever be settled till the able generals, admirals, and strategists we have in England are brought together to consider the question as a whole, and to devise a

practical scheme for its defence, to thrash out the question, and let them settle what really are the points to defend, what are vital to our lines of communication. And then, when you have a scheme, when you have it well ascertained in the best way you can, I think, if I may be permitted to make the remark, we should find that were a scheme put before the various parts of our Empire, and the Colonies were then invited to send representatives home to confer and to throw further light on this subject, between them all you would get such a scheme, so perfectly understood at home and abroad, that you would get hearty co-operation instead of each particular portion of the Empire frittering its money away in what they imagine to be the best means for providing for its own defence. In the way I have so roughly indicated, I think this may yet be possible, and I pray God it may, that the question of imperial defence will not only become popular, but be practically dealt with and successfully carried out.

The CHAIRMAN: It is part of my duty as Chairman to endeavour to draw out what has been virtually the verdict of the meeting upon this discussion. First, I wish to deprecate the idea that any discussions that go on in this place are actuated in any way by any sort of alarm or jealousy of any Power in the world. I, as a frequent offender in this room, can bear personal testimony that the great value of this Institution is, that it affords an arena where actual facts drawn from personal observation, and bearing upon our naval and military defences, can be fully discussed in a way that they could not be either on the quarter-deck or in the barrack-yard. The paper we have had before us, though it only invites our attention ostensibly to our naval and military stations in the Pacific Ocean, yet really raises the whole question of the naval and military defence of the Empire. It obliges us to take into consideration what are our interests all over the world, and how we can best dispose of our naval and military resources so as to secure them. And in that large and general aspect I may point out that there has come a change over naval warfare which somewhat more assimilates it to land warfare by the introduction of steam; and therefore one of the great maxims which has always been applicable to land warfare is, to some extent, also applicable to the sea, namely, that the main element of success is to be strongest at the decisive point, and at the decisive moment. That is especially important for naval people to consider now, on account of the fewer number of line-of-battle ships that it is possible for any nation to bring on to the sea. But at the same time no great maritime nation like ours can afford to let any of its dependencies be attacked with impunity. This nation has never so allowed it. In all the history of our former wars, wherever there was a threat upon our dependencies or our Colonies, a British fleet was immediately sent to the rescue. What are those interests, then, that we have to look to? There is, first, our commerce, which extends all over the world. Then there are the dependencies, those which are governed absolutely, and for whose welfare we are really responsible; and, thirdly, there are the Colonies, and in founding those Colonies we really have made ourselves a party to all their concerns as long as they hold to us. With regard to the particular sea that Captain Colomb has brought before us, he has pointed out that there are two great States growing in that sea, which are likely sooner or later seriously to affect our interests; those are Russia and America. It is not for us here to have any political feelings in the matter; we only deal with the facts of their progress, and the effect that it is likely to have on our interests. But we cannot help observing, from what he and others have told us, that in the advances of Russia in the Pacific there has been a steady persistence in surmounting one difficulty after another with a very strong hand, indicating a very definite purpose. At present there is little commerce to induce Russia to advance in those parts, and no doubt her progress is slow; but we find, from what has been told us, that as she advances step by step she makes secure her position, so that we may conclude that some day or another she anticipates reaping a harvest from such an expenditure of her power. On the other side the Pacific we find another great power advancing in a very different way, that is the overflow of a numerous and energetic people into a new land; but that advance is equally persistent and equally irrepressible, and we can, I think, have no doubt, from the opinion and information that has been given to us, that in the advance of America towards the north the annexation of one or two islands containing valuable coal would prove exceedingly acceptable, if it could

be accomplished in any legitimate way. Both these nations are no doubt fulfilling what they consider to be their mission in the world. We are not the people to complain of any nation so advancing; we do just the same ourselves, as has been said. Our progress, however, has been somewhat different, I think, from theirs. They have added territory on territory to their actual Empire; and upon that let me point out that the only real source of material strength in a nation is productive territory; all other resources are fluctuating and uncertain. Now, in our advance throughout the world, and especially in the Pacific, greatness has been thrust upon us. When we have got a little annexation of territory, we have been more occupied in groaning about the possible trouble and expense of dealing with it, than in feeling joy at the fact that another nursery of Englishmen has been created in the world. Nevertheless it is our duty to consider the extension of these other nations. What, then, will be the effect of any such extension upon our interests? What is the object of any nation extending its country? The greatest part of the wealth we have is derived from commerce with the tropical regions, where the great wealth of the world is stored up; and no doubt every nation must desire to get as much as possible of that of which at present we have the lion's share. We have sought commerce by sea, they seek it by land; and we must recollect that, as we are dependent in our island so very much upon commerce for our power, if a considerable portion of the trade of India and China were to leave the ocean highways and go by land, it would very materially affect our position in the world. We must at all events look forward, I think, that some day or another there will be a great rivalry of three or four nations in the Pacific for the commerce of those seas, and that that country which has cultivated its strength with a view to that contingency will carry off a chief part of the prize. In dealing with this question, from a war point of view, there is a great difference between continental nations and maritime nations. A compact continental nation has the advantage that its population is concentrated, and has one interest. It can lay out its defensive system, so that it can advance from favourable strong positions upon the enemy, or if attacked, can retreat from one such strong position to another into the heart of the people. Now a maritime or colonial state, whose population is scattered, ought to have some such strong central positions of interest and population at different parts of its empire, each capable of holding its own independently against any attack, and at the same time it must have strategic positions in the parts of the ocean best situated for attacking its probable enemies with combined naval and military forces. It is for the Imperial Government to consider where and in what number these centres and strategic points should be placed in our Empire, and what should be the relative strength of each. From that point of view we may take England itself as one great centre, the chief one, but no doubt there ought to be others. In the Atlantic Ocean and in the Indian Ocean we appear to have established some such centres, and also to have established some of these other strategic points, but apparently we have not got such positions in the Pacific. We must further recollect that in keeping up our connection with these great centres of our strength, it is not safe, upon the ocean, to depend upon one line of communication only. Here I would just mention that I most cordially agree with the officer who pointed out the great importance of our force of Royal Marines. I think the more this country grows, the more our Colonies grow; and the more our interests grow at sea, the more that force will be found to be of peculiar value in our whole system of defence. Now we have a very definite proposition put before us, and that is to create one such centre of naval and military force in the Pacific, say in Australia, and strategic positions, say at Singapore, Hong Kong, Vancouver's Island, perhaps King George's Sound, perhaps the Fiji Islands, perhaps the Falkland Islands. All this involves an expenditure of several millions; the defences alone of these points would probably cost two millions. And we have seen that at present there is very little existing in the way of war resources, or defence at any one of these places. Now if this sort of proposition is put before the Government, naturally the question would be, "What are the particular obligations or inducements you hold out to us why we should spend so much money in the Pacific?" The reply to this question has been before us in various ways in these two days of discussion. It appears that our trade between Great Britain and the Australian Colonies is about £40,000,000 a year; that our trade with China and

the trade between India and China and the countries adjacent, is about £90,000,000 a year ; that our trade with the West Coast of America is about £20,000,000 a year ; so that about £150,000,000 a year of our trade goes into the Pacific,—that is about one-fourth of our whole exports and imports, and that does not include any inter-colonial trade, except between India and China. Also it appears of this trade about £90,000,000 pass Singapore, £30,000,000 pass King George's Sound, and £30,000,000 pass the Falkland Islands. That will give you some sort of notion of the relative importance of these places as far as trade is concerned. The corollary of that part of the argument is the provision of coal for the security of that commerce. Coal is now, as the lecturer has told you, what provisions were formerly to a fleet ; but where you have a deposit of coal, there you must have the means of protecting it. Now, as a means of assisting you to consider the importance of the possession of coal stations, I do not know whether it has been pointed out in this discussion, or whether I have got it from other sources, but the coal-carrying power of a man-of-war at the present day may be said to be from 2,000 to 2,500 miles. They carry from 500 to 700 tons ; and, therefore, if we suppose that we have fifty ironclads in commission in war time, good or bad, and one or two hundred other steamers, 50,000 tons of coal would not go very far in providing our fleet with coal in a hot war. Then the Australian Colonies are situated approximately about half-way between the Cape of Good Hope and Cape Horn, that is 5,000 or 6,000 miles from each, or double the distance that our very best man-of-war could steam ; and the distance from Australia to Panama and Vancouver's Island is about 7,500 miles, or three times that distance. So that if it is necessary for us to do anything at all to protect our commerce and support our fleets there, we want some good provision for coal in that sea. Then again naval warfare is essentially a war of attack. No maritime nation ought to wait to be attacked, for that is inviting defeat ; therefore we must consider our coal supplies all over the world, not only with reference to the protection of our commerce, but also to the attack of the enemy. It appears that throughout the Pacific Ocean at present there are about eighteen places where a merchant ship or man-of-war may expect to find a stock of coal in time of peace, but of these nine are in foreign territory, and therefore not always available to us ; and of the other nine, which are in British territory, there is *not a single one* really properly defended at the present day. Then we have been told that there is coal in the Pacific, in Australia, New Zealand, Vancouver's Island, and on the north coast of China and Japan. Further, it has been said that it is a long way to send coal from England, and that it may be impossible to send it in war time, and also that coal is not a material that keeps well. These are additional reasons for it being desirable to secure supplies upon the spot, and also for establishing some system of keeping up the continual supply of fresh coal at certain places.

Now I come to another argument for keeping up the connection with our Colonies in particular, and for the defence of our whole Empire, that has been mentioned pretty warmly in the discussion, and that is the question of food supply. I think this has given rise to some misunderstanding on the subject of our island strength and ~~island~~ weakness. A great part of our island weakness consists in this, that we cannot supply our population with food. We may, perhaps, get it in time of war, for people will sell you things in time of war as well as in time of peace, if they can get the money for them ; but it may happen that the supply from some important country may be stopped altogether, and that is not a safe condition for thirty millions of people to be in, who draw half their food supplies from abroad. That makes it important, as has been observed, that we should keep up our connection with those Colonies which are food-producing countries. Again, some day we may expect that both Russia and the United States will double us in population, hence it is important for us to keep up a good and secure connection with countries that not only will supply us with food but also with men. Therefore I think we may say that the railway across British America is a matter of some importance, not only from the commercial but from the naval and military point of view. Some reference was made in the course of the discussion with regard to raising the money for these projects of defence. Mr. Hardy, the Secretary of State for War, alluded to that in this Institution, at the Annual Meeting. Referring particularly to our coal depots and the importance of providing and defending them, he said, as every British Minister does say :—“ It is a

question of money." It is quite true that it is a very considerable part of the question, although it is not one that we can go into here quite legitimately; but as far as we can judge from what we have heard here and out of doors, the Colonies seem to be perfectly ready to join us if they are called into council; and with regard to that point, I think there is one very great interest which they have in the matter, and it is this:—that considering the very great size that States are now growing to in the world, States such as Great Britain itself, and Russia, and America, it is almost impossible that any Colony of the size of Canada or Australia can remain entirely independent. It must be joined to some other great country, and I have no doubt, in the present feeling of the Colonies, there would be very little hesitation in choosing which country they would elect to remain with, and it has been pointed out that, even at the present time, the naval power of Russia in the Pacific, as compared with our own, is sufficient to cause alarm to our Colonies there. Therefore, on the whole, I think I may venture to say that the general opinions which have been extracted in the course of this discussion are, that there is very good reason for a national inquiry to be made by the Imperial Government, in connection with the Colonial Governments concerned, as to the best places for naval and military centres and for strategic positions. I think if that is recorded in our proceedings it will be the most legitimate and satisfactory way of meeting Captain Bedford Pim's proposal. That inquiry should, of course, include an examination into the extent and nature of the coal deposits in the Pacific. As one gentleman observed, it is difficult to produce any rapid effect upon public opinion in this country; we can only do it gradually. But meetings such as these, where the opinions of practical men, who know the places and circumstances, are expressed, and where we arrive at some definite conclusions, as I trust we have done to-day, will be found the best means of affecting public opinion, and through that decision causing the Government to take action. In conclusion, I will only say I hope, as Colonel Alcock very properly pointed out to us, that this will not be considered merely as a question of self-interest and of commerce. There are interests in the matter that we have which are superior to commerce. Commerce is only a means of acquiring power to use for some other purposes; and the other interest we have, is a responsibility that has been handed down to us, partly by the gifts of Providence and partly by the energies of our forefathers, of being the great propagators and guardians of liberty and religion in the world. Any question connected with the defences or the condition or interests of the Empire, should be discussed with a view not merely to particular local benefits, either in the United Kingdom or any one Colony, but so as to preserve our resources and to apply them to the carrying out of that duty that we have inherited. It only remains for me to ask you to return our thanks to Captain Colomb for the trouble he has taken in putting this important paper before the Institution.

the trade between India and China and the countries adjacent, is about £90,000,000 a year; that our trade with the West Coast of America is about £20,000,000 a year; so that about £150,000,000 a year of our trade goes into the Pacific,—that is about one-fourth of our whole exports and imports, and that does not include any inter-colonial trade, except between India and China. Also it appears of this trade about £90,000,000 pass Singapore, £30,000,000 pass King George's Sound, and £30,000,000 pass the Falkland Islands. That will give you some sort of notion of the relative importance of these places as far as trade is concerned. The corollary of that part of the argument is the provision of coal for the security of that commerce. Coal is now, as the lecturer has told you, what provisions were formerly to a fleet; but where you have a deposit of coal, there you must have the means of protecting it. Now, as a means of assisting you to consider the importance of the possession of coal stations, I do not know whether it has been pointed out in this discussion, or whether I have got it from other sources, but the coal-carrying power of a man-of-war at the present day may be said to be from 2,000 to 2,500 miles. They carry from 500 to 700 tons; and, therefore, if we suppose that we have fifty ironclads in commission in war time, good or bad, and one or two hundred other steamers, 50,000 tons of coal would not go very far in providing our fleet with coal in a hot war. Then the Australian Colonies are situated approximately about half-way between the Cape of Good Hope and Cape Horn, that is 5,000 or 6,000 miles from each, or double the distance that our very best man-of-war could steam; and the distance from Australia to Panama and Vancouver's Island is about 7,500 miles, or three times that distance. So that if it is necessary for us to do anything at all to protect our commerce and support our fleets there, we want some good provision for coal in that sea. Then again naval warfare is essentially a war of attack. No maritime nation ought to wait to be attacked, for that is inviting defeat; therefore we must consider our coal supplies all over the world, not only with reference to the protection of our commerce, but also to the attack of the enemy. It appears that throughout the Pacific Ocean at present there are about eighteen places where a merchant ship or man-of-war may expect to find a stock of coal in time of peace, but of these nine are in foreign territory, and therefore not always available to us; and of the other nine, which are in British territory, there is *not a single one* really properly defended at the present day. Then we have been told that there is coal in the Pacific, in Australia, New Zealand, Vancouver's Island, and on the north coast of China and Japan. Further, it has been said that it is a long way to send coal from England, and that it may be impossible to send it in war time, and also that coal is not a material that keeps well. These are additional reasons for it being desirable to secure supplies upon the spot, and also for establishing some system of keeping up the continual supply of fresh coal at certain places.

Now I come to another argument for keeping up the connection with our Colonies in particular, and for the defence of our whole Empire, that has been mentioned pretty warmly in the discussion, and that is the question of food supply. I think this has given rise to some misunderstanding on the subject of our island strength and island weakness. A great part of our island weakness consists in this, that we cannot supply our population with food. We may, perhaps, get it in time of war, for people will sell you things in time of war as well as in time of peace, if they can get the money for them; but it may happen that the supply from some important country may be stopped altogether, and that is not a safe condition for thirty millions of people to be in, who draw half their food supplies from abroad. That makes it important, as has been observed, that we should keep up our connection with those Colonies which are food-producing countries. Again, some day we may expect that both Russia and the United States will double us in population, hence it is important for us to keep up a good and secure connection with countries that not only will supply us with food but also with men. Therefore I think we may say that the railway across British America is a matter of some importance, not only from the commercial but from the naval and military point of view. Some reference was made in the course of the discussion with regard to raising the money for these projects of defence. Mr. Hardy, the Secretary of State for War, alluded to that in this Institution, at the Annual Meeting. Referring particularly to our coal depots and the importance of providing and defending them, he said, as every British Minister does say:—"It is a

question of money." It is quite true that it is a very considerable part of the question, although it is not one that we can go into here quite legitimately; but as far as we can judge from what we have heard here and out of doors, the Colonies seem to be perfectly ready to join us if they are called into council; and with regard to that point, I think there is one very great interest which they have in the matter, and it is this:—that considering the very great size that States are now growing to in the world, States such as Great Britain itself, and Russia, and America, it is almost impossible that any Colony of the size of Canada or Australia can remain entirely independent. It must be joined to some other great country, and I have no doubt, in the present feeling of the Colonies, there would be very little hesitation in choosing which country they would elect to remain with, and it has been pointed out that, even at the present time, the naval power of Russia in the Pacific, as compared with our own, is sufficient to cause alarm to our Colonies there. Therefore, on the whole, I think I may venture to say that the general opinions which have been extracted in the course of this discussion are, that there is very good reason for a national inquiry to be made by the Imperial Government, in connection with the Colonial Governments concerned, as to the best places for naval and military centres and for strategic positions. I think that if that is recorded in our proceedings it will be the most legitimate and satisfactory way of meeting Captain Bedford Pim's proposal. That inquiry should, of course, include an examination into the extent and nature of the coal deposits in the Pacific. As one gentleman observed, it is difficult to produce any rapid effect upon public opinion in this country; we can only do it gradually. But meetings such as these, where the opinions of practical men, who know the places and circumstances, are expressed, and where we arrive at some definite conclusions, as I trust we have done to-day, will be found the best means of affecting public opinion, and through that decision causing the Government to take action. In conclusion, I will only say I hope, as Colonel Alcock very properly pointed out to us, that this will not be considered merely as a question of self-interest and of commerce. There are interests in the matter that we have which are superior to commerce. Commerce is only a means of acquiring power to use for some other purposes; and the other interest we have, is a responsibility that has been handed down to us, partly by the gifts of Providence and partly by the energies of our forefathers, of being the great propagators and guardians of liberty and religion in the world. Any question connected with the defences or the condition or interests of the Empire, should be discussed with a view not merely to particular local benefits, either in the United Kingdom or any one Colony, but so as to preserve our resources and to apply them to the carrying out of that duty that we have inherited. It only remains for me to ask you to return our thanks to Captain Colomb for the trouble he has taken in putting this important paper before the Institution.

LECTURE.

Friday, June 8th, 1877.

ADMIRAL OF THE FLEET SIR HENRY J. CODRINGTON, K.C.B.,
Vice-Patron, in the Chair.

DEVELOPMENT OF OUR MODERN WAR FLEET.

By J. SCOTT RUSSELL, Esq., F.R.S., &c., &c.

I DEEM it a high honour that the duty has been assigned to me of laying before this meeting a summary of the new conditions which have arisen in Modern Naval Warfare, and of submitting to you the means we may be able to put into practical use for ensuring English naval supremacy over the oceans of the empire.

I highly appreciate this occasion, because I see in this Institution the most distinguished and the most experienced members of the two noble professions on whom we must always rely for the maintenance of the freedom, power, and well-being of the English nation; for with reference to war I believe no maxim more deeply true than that "Readiness for war means power to keep the peace," and there is one other less known but not less true that—

"Diplomacy makes wars—The army and navy end them."

As there are present members of both services who have fought battles in our past wars, and who will have to take a leading part in our coming wars, I desire to put myself, as far as I may be allowed, in the position of asking you for professional advice and information. I take my own position simply as an elder brother of another profession; and the duty of my profession is not to give you information on matters of war, but to ask you for information to enable my profession to do our duty by yours. Our duty then I take to be this—

"To prepare for your use—The fittest tools for your work."

Therefore I want to learn from you—

"What your work is to be—And how you wish to set about it."

Any information I possess as to the present wants of the naval service and the future fighting of the British fleet, I owe to the long and intimate knowledge I have enjoyed of the views and experiences of distinguished naval and artillery officers, and of men in command of war ships and fleets, not only in our own but in other services. In the Crimean War I am happy to say vessels of my design and construction, ably commanded and ably handled, did good service to our

country, and earned merited distinction for their Officers; and the Officers of successful smaller vessels of those days will, I have no doubt, successfully command our fleets of large ships in the coming war. It is the knowledge of our ablest naval commanders which I aim at possessing; if I ever made a good ship, it was by studying the wants of an able commander, and I have done my best to learn your present wants, and to consider and contrive the fittest means for the execution of your intentions. One defect in my address to this meeting I must apologise to you for. One of the objects of our "further development of our fleets" must be the criticism, correction, and remedy of the errors of the past and the present. Now if this paper had been read in other political circumstances, I might have undertaken the unpleasant duty of exposing the faults and blunders of our present ships of war. But at the present time that would not be prudent, useful, nor patriotic. These faults are well known to you and to me. But this is not a fit time to dwell on them. I will therefore omit this large, urgent, and interesting part of the question, and confine myself to the consideration of the nature of such new work as we shall soon have to undertake and to carry out.

About our existing ships of war I have only this to say, that according to my experience as ship builder, ship owner, and seaman, I have always found that a good captain makes a good ship, and an incompetent captain makes a helpless ship, and I firmly believe that our naval commanders will take what is called a bad ship to sea, and by mastering all her qualities, good and bad, by gaining the complete confidence of all on board, and by the exercise of forethought, foresight, coolness and courage, will make the best of such ship, engines and guns as they have got, and that what are called bad ships, may in good hands, win the victory.

In this paper I shall direct my attention solely to the determination of the objects we should mainly keep in view in the future development of the fleets of the empire, including in "empire," the shores of our colonies, the dominions of the British empire, and the oceans covered by our commerce.

The first question I have asked of your profession is this:—

What is a modern sea fight?

How do you mean to set about it?

The answers I have received have been many and various. But in the end, I think I understand what you mean to do. I think I see the like means to enable you to do it.

I.

A Modern Sea Fight.

Judging from all the information I have gathered from able and experienced commanders of fleets and ships, I think the following epitome illustrates their views and intentions; and, in order to master the subject and meet its difficulties, I have tried for the moment to put myself in the commander's place, and tried to understand his motives, means, and action, and thence I have tried to contrive and invent the means that would best fulfil his aims and achieve his end.

According to all the information I have gathered from the ablest men, the following series of facts are to be dealt with.

The Fight Begins.

Standing on the deck, 24 feet above the water,¹ I see my enemy clear on the horizon. He is seeking me. I am seeking him. We are six miles apart; at modest speed a mile takes six minutes; at that speed we shall meet in eighteen minutes.

What to do in these eighteen minutes is a serious question.

There is not a heavy sea on but an ordinary swell, our ships roll gently; steam steadily; our guns are charged; all is ready.

Now comes the serious question—As we approach shall we fire or not?

Twelve Minutes.

Six minutes have passed, and we are now within four miles of each other, shall we throw away our shot?

Six Minutes.

Six minutes more have passed, we are within 4,000 yards of each other, shall we throw away our shot?

Better reserve all for near and sure fire.

Three Minutes.

We are now end on. 2,000 yards apart. Three minutes of time left. Shall we continue end on?

Shall we change our course?

Why change our course?

I dare not change my course!

That is the answer to me by an able and experienced commander.

Now I quite agree with our brave seaman that he dare not change his course. It would be weakness. It would be fear. It might be folly.

His orders must be Stand by! Steady! Full speed ahead!

Three Minutes apart.

The three minutes are soon over! The engineer gets all in order for the crash! All in the ship is already made fast! The commander's eye never leaves the enemy. At the end of a minute, he sees the enemy hesitate.

He swerves to port! Port the helm is our order. The ship swerves to port, but is too slow to escape us.

The two minutes are over, he has not been able to get round more than four points. We also have got four points round, we are now full speed right athwart his beam.

Stem on. Stem into him. His side is open to the sea.

¹ My knowing this height exactly, enables me to tell his distance exactly.

Second Stage of Fight.

In this case we have won—and won easily. The weakness of our enemy was—to stay so long and swerve too late.

Suppose he had decided sooner, and gone about sooner, and been clearer, and we had done the same, he might have escaped collision. What then?—Then in passing him I should have delivered into him my entire broadside.

All this would have passed in twenty minutes from sighting, and in six minutes more we should either be once more broadside on or end on—as we were. The second meeting end on or broadside, one or both—unless one of us was already disabled—would be a repetition of the choice between meeting or swerving.

Alteration. First Stage.

Let us now go back to our original position—three minutes' apart, end on. The enemy does not swerve—we do not swerve—we meet full speed, stem to stem.

As there is a sea on and the ships gently roll, stem may not meet stem in perfect line, one of us will stem the other aside more or less. If we are both strong and well made, each may strike the other and rebound—damaged and not disabled—each may go on, discharge his broadside guns, and six minutes after we may be meeting end on or right athwart. Whichever side may win, it seems unlikely that one engagement between two such ships will last through more than three such encounters, or that the time of an engagement will be prolonged. Eighteen minutes to meet and eighteen minutes' close quarters seems a long fight.

It seems to me that the lessons I learn from these data are these—that the first fighting element I have to meet is “greatest strength to “strike my enemy with most harm to him and least to me,” that the second fighting element is “greatest gun power”—to throw the greatest number of largest shells into him with highest speed at close distance and in shortest time. These two are, it seems, the first fighting elements which the modern man-of-war must possess.

II.

Our Modern Man-of-War.

The first condition of the modern man-of-war is, that she be fit to fight this battle and sure to win it.

To fight and win we must be—

Speedier, so as to choose our own time and place.

Handier, so as to choose the best bearings.

Stronger Bowed, so as to sink him without being sunk.

With more Gun Power, so as to throw more and larger shells with greater initial velocity at close range.

How to get these fighting points without sacrificing any of the essentials of a seaworthy, sea-keeping, wholesome ship, leads into questions of practical detail. But before going into the details of our

future men-of-war, it is expedient to limit our aims by clearly defining the ends we have in view.

Do we aim at perfect impenetrability of armour-clad ships?

Do we aim at perfect unsinkability of the hulls of our ships?

Do we aim at perfect security of Officers and gunners, engineers and seamen, from risk of life and limb?

I ask these rather absurd questions, because we have had much talk here perhaps and elsewhere, of things called ships which are to be utterly impregnable and indestructible, impenetrable to shot, shell, fire and water.

In reply, then, I hope I may be allowed to assume that neither you nor I, nor any men in power, look forward to, or expect, or will sanction any pretence, of making the ships of the future war-navy perfectly impregnable; such fancies or pretences would be unworthy of your countenance and mere waste of time. No doubt a ship may be made to carry armour 1, 2, 3, 5 feet thick; no doubt guns can be made 100, 200, 300, 500 tons in weight, carrying shot of 1, 2, 3, 5 tons in weight; no doubt gun makers like to be paid for building monster guns; no doubt good blacksmiths like to be paid for rolling and hammering thick armour plates; no doubt also the talk about such big things may frighten our foes if they are fools, and might give confidence to our friends if they are fools. But I feel that I need not refute such follies in this society, because they would not be seriously entertained here.

I begin, then, by assuming that you don't expect me to talk of ships quite impenetrable to shot and shell of all kinds, ships quite unsinkable by shot and shell of any size, bottoms so strong as to anchor peacefully over a mine for the purpose of being blown up with impunity, guns so large that a single shot will sink a fleet, and an interior so large that provision and fuel can be carried for any number of battles all round the world.

If you were to desire me to indulge you in foolish fancies of that sort made for your amusement, I should begin at once with the wonderous round ships of which we have heard so much; I should tell you how if you made a round ship of 100 feet diameter, you might give her 1,000 tons of armour, 1,000 tons of guns and ammunition, and 1,000 tons of coal; if you made her 200 feet diameter, she would carry 4,000 tons of armour, 4,000 tons of guns, 4,000 tons of coal; if you went to 300 feet diameter, she would carry 9,000 tons of armour, 9,000 tons of guns, 9,000 tons of coal; how at 500 feet diameter she would carry 25,000 tons of armour, 25,000 tons of guns and ammunition, 25,000 tons of coal; how all the ships in the world might bombard her for twelve months without doing her serious harm, but amusing her and themselves by waste of powder and shot.

All this you might take in good part if we were met here merely for fun. It might also amuse you to know that I really designed such a gigantic round floating fortress twenty years ago for real use, but I never called that a ship, and I hope you will never consider one of such, or any number of them, as a ship or as a fleet.

I understand, therefore, that we are not here talking of circular

batteries, floating forts, or any of those fancies which fertile imagination may disport in creating; but we are to consider how we may make sure progress, in creating sea-going, sea-keeping, speedy, handy ships, on given conditions of least waste of money, time, and human life, and meant for the purpose of protecting the wide-spread interests of the English race, the empire of the ocean, and the commerce of our large colonial family with the mother country and with the shores of all seas, and for the purpose of dealing summarily with the ships of any enemy who may wish to capture our wide-spread fleets of merchantmen and plunder the wealth they carry, or who may be ambitious of attaching to their own empires, some of that large family of English colonies, and of English dominions, which do so much for the wealth, well-being, civilization, liberty, and progress of human society. That family we must protect at all risks, and it is to the larger question of thus protecting the interests, the honour, and the power of the British Empire, that I have directed my thoughts in preparing to address this meeting of England's protectors.

III.

Ramming Power and Bow Structure.

Since ramming power takes first rank in the war ship, I have carefully examined our own ships and other people's with the aim of seeing what kind of ram or stem will do them most harm and sink them soonest.

I find that cutting them open "across the water-line" is the way and place to do most harm and sink them soonest. The best tool for this purpose is a good upright seagoing stem, having its greatest projection at its own water-line and rounded backwards above and below. This is also a good shape of stem for a sea-going ship.

I do not find that the sharp point or underwater beak often used, is a good weapon. It weakens the ship, gives a lever to the enemy, and makes a small opening instead of a great one. What is wanted, is a stem which is the strongest and at the same time opens up the largest part of the enemy in the most dangerous place. To cut open the water-line above and below, will let in most water in the place to do most harm and soonest sink the ship.

That a nearly upright stem rounded back above and below the water-line, will do most harm is plain from this circumstance, that it cuts across the decks. A sharp point may penetrate between two decks which are watertight, and do little harm, admitting water only on one deck; but an upright stem cutting across two decks, lets water in to fill three decks, and as the entrance of water heels the ship over, more and more of the opening gets under water and much more of the ship is inundated. I should much prefer my ship being pierced by a sharp point than cut open across my decks.

I am also of opinion that our stemming structure is weak. A strong heavy lump of iron called a stem is really a very feeble offensive weapon, because it is not so made as to be in one with all the ship behind. Hence we see that the ship which rams, is often more injured

than the other. I have seen ships that have rammed others at sea come back sinking because their bows and stems were not so made as to give each other due support.

The stem of a ramming ship should be built up quite differently from past custom. Our large single forgings, stopping short in thin iron sheets, are simply useless dead weight, and an oblique collision with an iron-plated ship will simply double the bow round, if not tear it open.

What we want in collision-construction is that the strong thick parts of the ship should grow evenly out of the weaker thinner parts abaft, so that the strain of collision shall be spread over a wide space, and so utilizing the strength of a large extent of good iron. For this purpose the stem must be formed by gradually growing out of the ship's bows in plates overlapping thicker and thicker until they become a thick, smooth inflexible stem, quite different from common patchwork.

The same principle must prevail throughout the whole bow of a ship. The decks must all be incorporated in the interior of the hull with the skin and the stem, so as to form one entire hollow weapon of great strength and homogeneous structure, without the present points of weakness. This, though practicable, requires much skill in order to get most work without weakness and without waste.

By stem and bow strength, I mean not merely on and under water, but up to the summit of the bow. The ship must be too strong for her enemy, not at one place, but all round the bow.

IV.

Precaution and Protection by Casemates.

Although I adhere to the war maxim, that sinking your enemy means saving you, I do not therefore feel myself thereby discharged from any of the responsibilities of my duty to do all that in me lies to save your life, and so aid you in your duty by first doing mine. But I beg to say that my idea of my duty and yours is, that harming the enemy is your first duty and mine, that saving ourselves is the second duty, and that we must not sacrifice the first to the second.

Our first duty being to shell our enemy and to sink him, I must ask you to agree with me in first giving our ship more sea-worthy qualities, more endurance, more speed, more handiness, more sinking power, and more shelling power than our enemy.

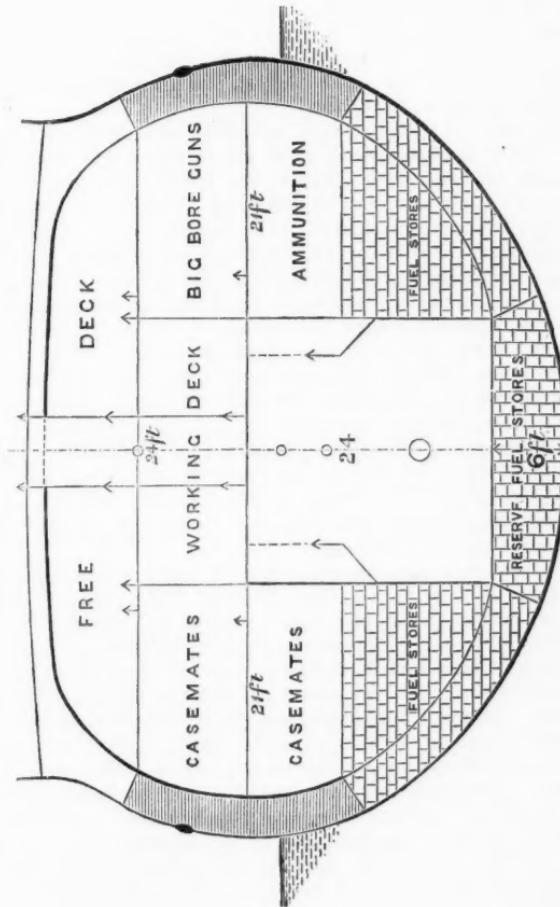
Saving power for ourselves, I should give as follows. I should give up all long clear level decks under water, and take exclusively to what I will venture to call—

The System of Casemates.

The casemate system is that in which we take some convenient unit of bulk, having some practical use as its aim and measure. For this end I take one broadside gun as my unit for bulk. That gun wants room to work it. That room may be 12 feet wide by 18 feet, call it

DIAGRAM I.

Diagram of the Cross Section of Armoured Ship with Broadside Big Bore Guns in Casemates.



220 square feet of deck; or if 10 feet will do for the gun call it 10 feet by 22. Height between decks we need not now fix. My first step for safety which I am ready to take, is to divide the whole broadside of the ship into casemates of 12 feet each, and to place in each one its own big bore shell gun. I can so arrange the structure of those casemates that they shall add nothing to the dead weight of the ship, but, on the contrary, give it useful strength.

These casemates will have these characteristics. Entry only from above. They will be water-tight and air-tight. Enemies' shell exploding in one will not reach the rest. Water entering one will remain there, not spread to the others.

This casemate system I do not mean to confine to this gun deck only. Each casemate shall have under it, an underwater casemate containing all shot, shell, charges, and stores pertaining to that gun, and to the ship's company of that gun. During battle no one need leave that casemate but one; that one stands on the upper deck, or at least has his head above it, and sees and knows all he should, and has complete command of his gun and gunners below. Thus we have now a unit of our war ship. We can carry in twenty casemates, each 11 feet by 20 feet, twenty big bore shell guns.

We can carry on the other side twenty more. Thus, in a ship's midship body, 220 feet long, we carry forty big bore shell guns. If one broadside of such shells do no harm to our enemy, he must be hard to harm, we have no choice left but run him down.

As to our own protection. If he is run down we are safe. If we miss and he shells us, look at our position. If he aim well and pierce us with one of his four great guns, he may disable one of our guns and harm the gunners. But that is a loss of 1 in 40, not 1 in 4, which is his loss if we harm his gun.

Now this casemate system is all we can do, and should be fully carried out in every ship having big bore shell guns in great force. It must be extended to the boiler-room and engine-room equally. Instead of communicating everywhere, the boilers of a large ship must be shut in all round so that when explosion comes from causes without or causes within, the explosion shall confine itself to that one closed chamber. This I did in the Great Eastern, and thereby I saved the lives of the multitude then on board. Each of the five distinct sets of boilers was entered only from above, and enclosed in a water-tight casemate. A foolish auxiliary boiler, meant to save a little scrap of fuel, and called a superheater, was added to the ship's boilers by the owners of the ship in opposition to the judgment and contrary to the advice of the builder. It blew up, as it should have done, and tore open the adjacent boiler and killed the men in the engine-room. But, thanks to the complete seclusion of that one set of boilers in their own closed compartment, we who were outside, and we were many, escaped, and the rest of the boilers and machinery continued their work unharmed, and took the ship to her destination. It is, therefore, not from fancy but from hard facts that I entreat you to save the lives of your men on board your ships by the means which saved mine—the system of casemates and closed compartments entered only from above.

I have carried out this system throughout the plans of several ships, and I cannot say that I find any disadvantage at all comparable in value to the safety of life and security from sinking, which it, and it alone, can give.

But I am bound to tell you that the planning and working out such a system has one disadvantage. It requires much forethought, foresight, and skill in those who plan it, and much of the same qualities in those who use it. But in this it resembles all other improvements which are new, and to which we have not been practically educated and trained. It requires time to mature its structure, its use, and its users, therefore the sooner we earnestly set about it the better.

These casemates clothed in armour will carry each a great bore gun, and a similar casemate below the water-line will carry ammunition for that gun. The sub-divisions of the ship's hold going down to the ship's floor, and going right across the ship, will form continuations of these casemates, and thus the whole will be one homogeneous structure of wrought iron plate, disposed in the best way, without waste of weight, and each part contributing its full share to strength, safety, and effect.

V.

Strength of Armour and Ship.

Giving up as fanciful all ideas of perfect impenetrability, we go into the plain problem of making the best of what we can have. If I can carry 1,000 tons of armour in a given ship, how shall I best dispose it?

I have so much area to cover, so many guns to protect, so many tons dead weight to carry.

Here the practical problem begins and ends, how to make the most of say each 50 tons of armour.

The gun I have to protect occupies a casemate, having an exposed face of say 100 square feet. If each foot of armour over a foot thick weighs 5 cwt., that will use 25 tons, leaving 25 tons more for end-on and under-water protection.

The question is now this, how shall I best utilize these 25 tons over 100 feet of face, so as to be most enduring. The answers to this are most important:—

1st. What shall the armour be? hard iron or soft? iron or steel? or both?

On this I shall give you the sum of my own experience and of others, as far as I know theirs.

1. Joints in armour are weak places, therefore let us make them the strongest.

2. Bolts and bolt-holes are causes of cracks and giving way, therefore do away with bolts and bolt-holes.

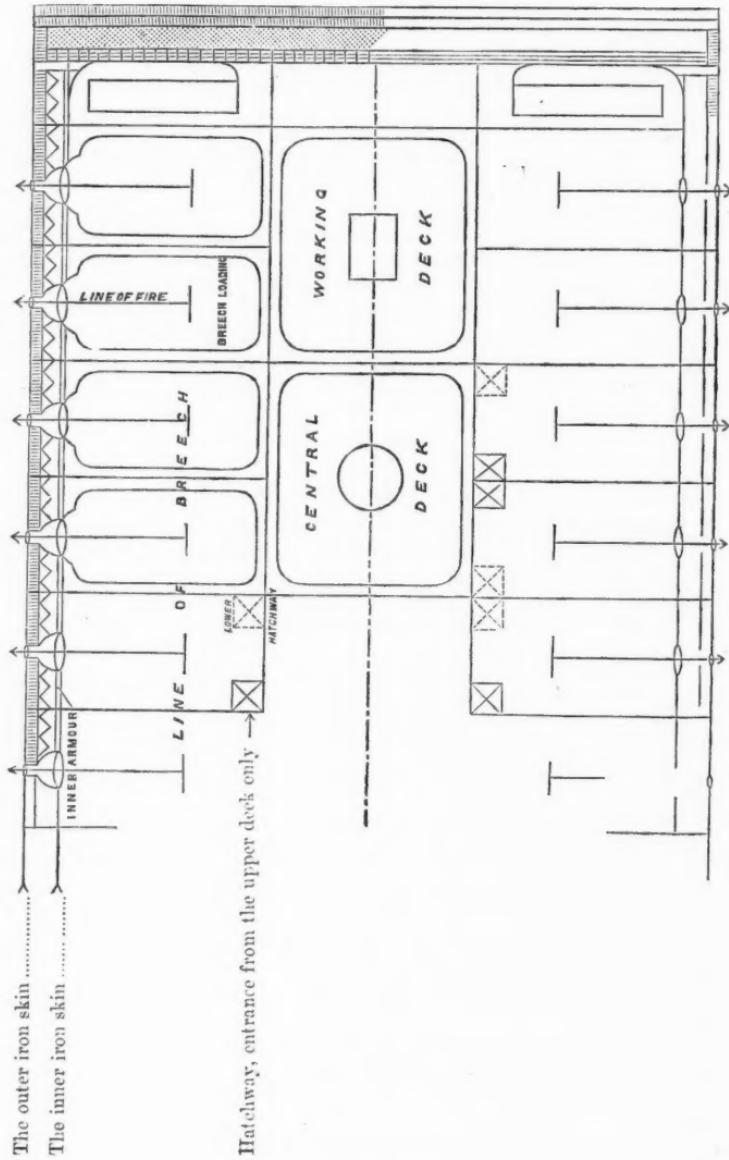
How this may be done? Our system of casemates enables us to do this.

A modern armour plate covers over 100 square feet, in one single piece, it weighs 25 tons. But it is pierced with holes, and its joints

The Cross Fore Bulkhead and Armour.

DIAGRAM II.

Diagram of forward portion of Upper Casemate Deck showing place of Armour and Guns and strength of Structure.



are weaknesses. Struck on a joint it gives in there and flies out at the far-off edges. Struck between two holes it cracks between. Now if we place the whole four edges of the plate on the four walls of our casemate, all four thus supported, become the strongest place in the plate.

If therefore it be true that the strength of everything is measured by that of its weakest part, we have by our casemate system much strengthened our armour.

Next, as to the quality of our armour-plate; shall it be hard or soft? steel or iron?

This question requires careful discrimination. Doubtless the harder it is, like tempered steel, the more it shatters the shot of the enemy. But also we must remember that hard stuff cracks, and so, though the shots of the enemy are shattered, yet later on, our armour is itself shattered, cracks, and falls to pieces.

Our question therefore comes to this, can we get all the advantages of steel armour, and yet protect our armour from crumbling to pieces?

First then we must fasten it to our ship without bolts or bolt-holes; next we must hold it in place by such means that though split by shot, the pieces may still be retained in their places, and do their work as armour.

There are several ways to do this. One I tried at Shoeburyness was an edge binding, where the plates were riveted in places without bolt-holes, and it certainly resisted better than any of the others. But there is a much better way not yet put into practice.

This way, which I propose should be put into practice along with the casemate system, is to incorporate the armour-plate within the structure of the iron plates of the ship. There need be no armour-plates nor joints visible outside the ship, only the common iron skin quite smooth on the outer appearance of the ship; then the ship itself built, like the Great Eastern, with broad plates at right angles to each other, and forming a cellular skin. The spaces of this cellular skin to be made of such sizes as each to hold a large armour-plate and its backing, and this entire skin and its divisions built up of iron plating two or three layers thick.

By this system of incorporating the steel armour or iron armour inside the hollow walls of the ship's side, the armour would add to the strength of the ship's structure, and the ship's structure would enclose the armour without piercing it with holes and making it crack, and if it were cracked by some extraordinary force, the two or more pieces of the cracked plate would still be secured fast in their place, and would still be there to receive the blow of the next shot, with diminished strength, but not destroyed nor removed. That I think would be the way, in union with casemates, to make both the ship the strongest and safest, and the armour most effective, secure, and durable.

Thus 50 tons of armour gives us protected casemates for one gun of the twenty guns in twenty casemates for the weight of 1,000 tons of armour.

I think that by means of this arrangement we have made the most of our money, weights, and material.

Of course double these weights and cost would give double thickness of armour, but the same methods of application would yield similar advantage in use, should such weight be deemed expedient. But that question comes later, when we settle the size of ship.

VI.

The Man-of-War.—Ship of the Line.

In designing a ship of war, the first maxim I should entreat you to adopt would be, not to allow any of the usual prejudices in favour of or against any particular proportions, shapes, or modes of construction to affect your minds, but to follow out implicitly the conditions and wants of the case and the nature of the work the ship has to do.

1. Let us agree that the ship shall have the shape, proportion, and qualities of a sea-going ship; shall stand up well under sail and roll easily with the sea; shall be dry and handy. We know that these qualities have been completely obtained in many ships of the past.

2. Let us agree that our modern man-of-war must go fourteen knots under steam. This settles the shape of bow and stern; the length of entrance and run, 200 feet.

3. Let us agree that our ship must carry fuel for 3,000 miles, 4,000 miles, or 5,000 miles. That settles whether she is to be 300 feet long or 360 or 400 feet long. See diagram III.

4. Let it be agreed that she must carry 2,000 tons of armour and 2,000 tons of armament and ammunition. That settles her breadth of beam as say 64 feet.

5. It must be understood that the middle body of the ship protected by armour should be adequate to secure the ship when the unprotected ends are shelled.

The result of these conditions, without any choice on your part or mine, give us a—

Ship of the line 66 feet beam, 24 feet draft, 300, 360, 400 feet long, the length of the ship being proportioned to the length of the voyage she can make or the time of her endurance at work.

The entire water-borne weight is 12,000 tons; the weight of ship, equipment and engines is 5,000 tons; armour and armament, 4,000 tons; fuel for ocean voyage, 3,000 tons.

This store of fuel is good for 6,000 miles. Diminished length of 10 feet of ship makes 300 miles diminished length of voyage.

Thus built of 300 feet long, this ship is good for only 3,000 miles steaming; 360 feet long for 4,800 miles steaming; 400 feet for 6,000 miles steaming.

Now on the point whether you would prefer the longer ship, to enable you to seek your enemy further, to follow him faster, to choose your time with more margin in hand; all these are points for your choice, not mine.

Let us now see how we can turn all this weight of carrying power to account. We have 4,000 tons for armament and armour: say 2,000 tons armour, 2,000 tons guns, ammunition, and stores; 1,000 tons

guns and carriages; 1,000 tons ammunition, &c.; being 10 guns of 100 tons, or 20 of 50 tons, or 40 of 25 tons.

I have already said how I should wish to see the armour and protection carried out and the guns placed broadside in casemates. But the question of choice of guns is more yours than mine. I prefer a given weight of large-bore gun firing large shells with high initial velocity at close quarters, breech-loaders, and placed in very simple carriages in armoured casemates, to all the complex mechanism and misplaced ingenuity of firing long, narrow, thin shot, from long distances on a heaving sea.

It will be seen that if this ship, 66 feet beam, were only six beams in length, which we have always reckoned a very moderate proportion in steamships, she would be 396 feet long. But it is objected to length, that it cannot be combined with quick turning or manoeuvring power. Now this is true in degree, but in degree only. I can quite undertake that the turning power or manoeuvring power of our warships can be made such that a ship 400 feet long shall turn round quicker and sharper than our present war ships of 300 feet long. How this is to be done I shall consider further on.

Table of Dimensions.

I. THE MAN-OF-WAR.

(66 feet beam, 25 feet draught.)

Lengths.	Bearing Power.	Steaming Power.
Feet.	Tons.	Miles.
300	8,000	3,000
360	10,500	5,000
396	12,000	6,000

IIa. THE FRIGATE.

(56 feet beam, 25 feet draught.)

Lengths.	Bearing Power.	Steaming Power.
Feet.	Tons.	Miles.
300	7,000	3,000
360	9,000	5,000
396	10,500	6,000

IIb. THE FRIGATE.

(46 feet beam, 25 feet draught.)

Lengths.	Bearing Power.	Steaming Power.
Feet.	Tons.	Miles.
300	5,500	3,000
360	7,000	5,000
396	8,000	6,000

DIAGRAM III.

Diagram of Water-line of High-Speed Ships; showing relation of endurance of Steam Power to Length of Middle Body, the Ends being alike.

4½ beams long. 300 feet. Endurance, 3,000 miles.



5½ beams long. 360 feet. Endurance, 5,000 miles.



6 beams long. 396 feet. Endurance, 6,000 miles.



VII.

Gunnery and Manœuvres at Sea.

All my experience of the sea, (and I am very fond of the waves and enjoy their play,) has given me the belief that with our present large guns, very little good is got by complex manœuvres of the gun. To say that the gunner can lay his gun as he used, by peeping through the port and adjust it with all the nice precision of a land gun, is sheer nonsense, and, if I am well informed, all such sea-gunnery is sheer waste.

I have come to the conclusion that the modern ship is the true gun-carriage, and the chief gunner is the man who commands the ship, and that the guns of the ship are laid just as the ship's head is laid.

I beg you, therefore, to go back with me to our opening sea fight. I presume that on entering that engagement, the Commander had four large bore guns laid right a-head in the line of the keel, and that as he kept her head direct on the enemy, stem to stem, so they only received a signal to fire and reload. Being breech-loaders this could be done without deranging the gun, and without loss of time. But I fancy the firing may have been wisely reserved. I presume, also, that the Commander on sighting the enemy, had all his twenty or forty broadside guns laid right across the beam, and at such elevation as the state of the sea rendered most serviceable. Some talk of converging broadsides as useful, I prefer square across the beam. Now the Commander of the ship, standing where he should, sees all that happens without, and guides all that is to happen within, knowing now how every gun lies, and having only two such ways to think of, he is, I think, quite master of the situation.

He has only to see the ship's head right in line with his enemy to fire with certainty, and if he do not give him the stem but pass him, he will surely deliver into him the entire broadside.

Now all this is coolness and courage, and forethought and wisdom, but it requires no tricks of gunnery, and no marvellous, ingenious, costly, complex mechanism of any kind; its sole virtue is simplicity, common sense, and cool courage.

In this case then, and in many others, I call the ship the gun-carriage, and the Commander the gunner-in-chief, and thus I dismiss all bewildering complications.

Being breech-loaders, the guns are at once reloaded without being in any way shifted or altered, and one minute may suffice with good organization. All is again ready and nothing changed but the ship's place, and the Commander is giving the guns the proper direction by the ship's head.

I wish here to say a few words about the ports of armoured ships. The ports of which I made the designs, were made small and narrow; I have lately seen the ports of armoured ships made wide, open, and large; and I have even seen them shaped with funnel-like mouths spreading out wide, just such as I should like to fire into if she were my enemy, for I could not fail to fire my shell right into her central battery, even with my clumsy aim. Now, I have a growing conviction

that we cannot, in our armoured ships, too much diminish the size of our iron-clad ports. Years ago some of us contrived muzzle-pivots for our guns; the principle has been revived, some foreign governments have tried it with success. I can conceive nothing better for an armoured casemate than a closed port and a muzzle pivot, no smoke and no bullets could then enter, and the gun, already laid in an already ordered line, would obey the orders of the gunner-in-chief. On this arrangement I place high value; any of its seeming difficulties are easily got over.

By arrangements such as these, difficulties of gunnery and gun-carriages, and laying and loading, speedily disappear, and the Officer in command may feel that he is in real command of his ship, instead of feeling himself the victim of mechanism and machinery over which he can exercise no control.

What I have here said relates chiefly to the guns in casemates of the ship of the line. I may afterwards show its important bearing on ships of a smaller class. The four chase guns at each end of the ship may have longer range and wider training.

Another Kind of Fight.

There is one way to avoid ramming and being rammed—"running away."

There are cases in which running away might be wise. You are stronger than me, I am faster than you; I run away, you follow, and I escape.

But though I may seem to you to run away, and you follow, I may choose to fight you as I run. I may have good armour end-on, though I may have none broadside (or little). I may also have good guns end-on. In this case, though you have also good guns and plenty of armour, I with more speed, am a match for you.

This may be a good reason why I seem to run away. I may fire directly into you without changing my course. I by speed can keep nearer you or farther off. I, as I go farther, may use vertical fire, falling on your decks. Thus with little armour I may match you by speed and good armament and simple armour.

VIII.

Other Kinds of Ships.

If we have war-fleets at all, should we have any but the most powerful ships, with most speed, most great bore guns, most complete armour, most endurance at sea?

I must confess to you that the deeper I go into the question, the more I come to the conclusion that the first-rate war-ship, though the most costly, is the best worth her cost.

I much prefer one strong ship to two weaker ones.

For the naval strength of our great empire, I can see no war-engine comparable to a fleet of ten or twelve ships of the line; all identical each to each in every point and quality; all seaworthy, fast, and enduring; all with many large bore guns, and complete unsinkable

hull and armour; all able and ready to go round the empire and fight whenever they can find an enemy, quick and handy.

Among other possible ships, are ships of the same length, of less breadth only, and having the same qualities. These we may call frigates, and their only difference is—wanting complete armour.

By "complete armour" let us agree that we mean a middle body with all in it protected, and long enough to sustain itself and the fore and after ends of the ship.

By "partial armour" let us understand:—

I. Two transverse sections fore and aft, protecting all decks, engines, and magazines from end-on fire; call that the lowest degree of armour.

II. The next degree should add to this, armour for magazines, engines and boilers, and an armour deck covering them.

The higher degree let us call complete armour. I should give as a rough estimate—that the complete armour being 2,000 tons, the 2nd rate armour would be 1,000 tons, the 3rd rate armour 500 tons. Now we see that the addition of the complete armour, as compared to its lower degree, is only a difference of 1,000 tons, in a displacement already of ten or eleven thousand. So I conclude that the advantage preponderates for complete armour in the larger classes of men-of-war.

The second class of armour-clad is the frigate. Its two bulkheads give it complete end-on protection. Its casemates limit the dangers of the exposed side. Its low armour over magazines, engines, and boilers secure its vitals even from broadside fire, while its ends save all within from raking and sweeping fire. It is narrower and cheaper than a first-rate.

Now this class must be the fastest of all. It must be able to follow and catch any ship it wants to get hold of. It must be able to get away from vessels able to sink it. It must be able to return to us before our enemy can follow. It must be able not only to chase with effect, but to be chased with impunity; its chase guns and its two bulkheads give it this power.

III. Whether this class should be classed as corvettes, and a smaller class called sloops should be employed chiefly as intelligence ships, with no powers at all except that of running away from armoured ships, is a question I must leave to others. I would rather omit such ships altogether from the fleet, and include them and all others under the general head of *Special Service Ships*—mortar-boats, torpedo-boats, under-water boats, monitors, turret-ships.

I doubt if much good is got by going down from ship of the line to frigate. It is cheaper and less wide, that is all.

But we may want a ship of less draught of water, and greater speed than ourselves, to form the flying squadron of the fleet. If we are taking charge of some sea—The Mediterranean, the Indian Ocean, the North Pacific, the Australian Ocean, the West Indian Seas—we want ships to be everywhere, to watch everything, to deal with smaller enemies, and to protect our own smaller interests; we must have a sort of ubiquitous ship—something like the German Uhlans, which I used to

see on the outlook, all over France during the war. It seemed to me just what we must do with ships in seas when we have to make war.

IX.

Ships for Exceptional Service and Special Duties.

Mines and Shells.

The question of torpedoes, mines, and under-water attack is one which no Commander of a ship and no constructor of a Navy can neglect, but it is also one which has attracted much more attention by nervous excitement, alarm, and fear, than by real force as an instrument of Naval war.

As ever since the beginning of the Crimean War I have given much study to the question of under-water warfare, allow me very shortly to deal with this matter as it regards fleets. There are many engines of war which are quite as dangerous to the enemy as to us: mines and explosives generally are of that nature; shells and explosives generally are of that nature. I will try to put all I think useful to you in that matter into few words.

From my own personal knowledge and experience I can tell you thus much. If you are my enemy and lie near my shores in smooth water, I can, with a very small ship or gunboat, do the following things to you:—

1st. I can fire large explosive shells upwards which shall fall vertically downwards through your deck and explode in the midst of your ship.

2nd. I can send these same shells horizontally above water and strike you horizontally about the water-line, above or below.

3rd. I can send these same shells down below water, right under the bottom of the ship, and there explode them at the same moment at which shells are descending and exploding from above.

Now all these things I can do with certainty and not without risk, if you allow me; but I need not add, that you are a fool if you allow me.

Allow me to say that I think these are much more matters of fright than of fight. Rockets frighten savages more than bullets. Greek fire was a grand cause of alarm in old times.

I should make myself well acquainted with all such matters if I were a Naval Officer. I should amuse myself with them, and make my men quite familiar with them, and able to use them to frighten the enemy, but I should not trust to them as an instrument of serious warfare.

The one answer to all is—destroy your enemies before they get near you. That easy task I leave to you. That every fleet shall be composed of a different class of ship, charged with different kinds of duty is now plain—that is a matter of naval strategics on which I need not enter. But I have no doubt that it will be the duty of the numerous classes of small vessels of the fleet, to see that no small ships of the enemy come near to the main body of the fleet so as to shell them either above water or under water, torpedo-wise or otherwise.

If great ships allow little ships to come near them and shell them they deserve to be sunk. A torpedo-boat is as easy to sink as any other boat, if not easier.

All I have to say in the matter of ship-construction is this—that every ship of war must be planned with full knowledge of the fact that the shell is the engine of naval warfare. That it must be thrown out in whatever direction will give best effect, and that protection must be afforded against shells from every direction in the manner we find to be most effectual.

In every case there remains only this one rule of war—

“Sink him first.”

There is no other.

X.

Gun-Boats.

I rank the gun-boat, with one big bore gun, as the class of war vessel next in importance to the ship of the line.

There is this important distinction between them—the fleet of large men-of-war is ready and able to go to any of the seas of the British Empire, and there to win a victory over the fleets of any of the enemies of our power or our commerce. But the fleets of small ships must be *localized*, they must be already in the place where our interests lie. They cannot carry coal to steam thousands of miles. They cannot accompany the ocean fleets, they must precede them. Local flotillas of our modern gun-boats I consider as a good school for the future training of the crews and officers of the Imperial Navy. In our great stations in the Indian ocean, in the Australian seas, at the Cape, in the West India Islands, as well as near our own homes, there should be completely organized flotillas of the smaller classes of war vessels, in good harbours and well-protected stations, to which in case of war our large men-of-war fleets might be dispatched with the highest speed, and find these fortresses and their local flotillas ready to join them with perfect equipment, and ably manned and commanded.

The question of the construction of this class I consider to be one of the highest national value. I venture to call it—

The Unit of the Fleet.

It is the smallest ship, but it carries the large bore gun, equal to that in the largest man-of-war. The reason I do not follow the common course of placing a small gun in a small ship is this—that the bore of the gun is not settled by the size of the ship that attacks, but by the strength of the ship it has to conquer.

As our unit has to attack the largest and strongest ship, it must have a gun fit to fire a large bore shell with a high initial speed, otherwise little bore guns against strong ships are worthless.

The next point of importance in this unit of the fleet is that the gun-boat shall be the gun carriage. It needs no other. The boat built with a strong thick iron bow will be the gun carriage, and

the water in which the boat floats will take the recoil, no other is needed.

The gun boat being the gun carriage, must be cleverly handled by an able gunner and a clever commander. Therefore also the manœuvring power of the vessel must be made a first object of design and construction. Ordinary screw propelled boats have many disadvantages in handling them. These the ingenuity of England must be asked to remedy. It is to be remedied in several ways, and a little experience will soon show which is the best.

Assuming that this one-gun vessel is taken as our unit, and that her gun has 15 inches bore, and 18 or 36 tons weight, the vessel herself will have to be not less than 25 feet beam, and probably more than 150 feet long. But with that short length, she will neither have high speed nor endurance of fuel for length of run.

Calling the one-gun boat the unit, I think it very important to have another class, which I will call the twin-gun boat, because she will be able to mount two of these big guns, one fore and the other aft, and she will be able to go with equal speed either way, and be capable of manœuvring equally well either end foremost. She will have to be longer, and she will be able to make a longer voyage with a greater store of coal, and though she has more length than the unit, she will manœuvre equally well, from being able to stem either end foremost at full speed with full manœuvring power.

But with these qualities, let it not be forgotten that a single large shell sent into her centre by a first-rate man-of-war sends her to the bottom.

In this respect therefore two units are better than one twin.

In conclusion, I think a few hundreds of such gun boats all round our coasts would make good seamen gunners of us all.

Conclusion.

If I may now venture to sum up the conclusions to which I should desire the present discussion to lead us, they are the following:—

1. That the construction of ocean fleets of men-of-war, able to keep the sea, in all the stations of the empire where British rule and British interests require protection, is a matter of national as much as professional interest.

2. That the creation of a new fleet or fleets as distinguished from the maintenance and repair and restoration of existing fleets, is a great national act rather than a matter of ordinary administrative routine.

3. That the creation of an ocean fleet or fleets is not to be accomplished without a great national effort, in which the industry, the commerce, and the financial resources of the country, as well as its professional abilities, must all be brought into cordial and patriotic co-operation.

4. That a standard Naval gun of large bore and light weight, breech-loading, and so arranged as to fire through a small closed port, and worked by simple means, is a desideratum in the Naval service.

5. That a system of Naval casemates, enclosing broadside-guns, having steel and iron armour, the armour so incorporated with the

ship's side as each to contribute to the strength of the other, offers great security against shot and shell, and much safety against ramming and sinking.

6. That a similar system of division and subdivision, in the compartments of boilers and engines and in stokeholes, coal bunkers, and tanks, offers the best security against dangers from within and without.

7. That a speed of 14 knots should be the normal speed of an ocean fleet, and that a minimum steaming power of 5,000 miles, should be the normal endurance of the steam ships of the fleet.

8. That improved manoeuvring power in screw men-of-war, is a desideratum, which may be accomplished in several ways, and which deserves to be made the subject of study and invention and trial for use in the service.

9. That a large and powerful sea-keeping man-of-war, and a small quick one-gun boat or twin-gun boat, are the two most important units of a navy.

10. That the large squadrons of the fleet should be ready for service in every sea of the British Empire; while the small vessels should be localized in well defended Imperial stations—placed where the most important interests have to be defended.

11. I submit that a man-of-war can now be constructed with a speed of 14 knots, an endurance of 5,000 to 6,000 miles steaming, the sea-going qualities of a sailing ship—easy, stable, and handy, carrying 20 to 30 big bore broadside guns of 15 inches, all under complete armour, and an over match for any existing man-of-war, under 396 feet long, and able to turn round quicker than existing and shorter ships.

12. I also submit that we should adopt the one big bore gun boat and the twin-gun boat with high speed, exceptional turning power, and speedy reversal power, as the unit of our flotillas of small men-of-war.

The CHAIRMAN: After the very interesting lecture we have heard, and the instruction we have derived from it, I hope there are many gentlemen present who will contribute to our information. Even if they do not agree with the lecturer, their criticisms will doubtless give us still further information on this interesting subject. There are one or two points I should like to hear something more about. One is as to the strength of these casemates to resist the explosion of a shell. It would resist, perhaps, water, but would it resist the explosion of an enemy's shell that came in from above?

Mr. SCOTT RUSSELL: It will, not without injury to itself, but it will not injure those that are around it. It will be bulged a little, but it will save those above it. I have been in a ship where a large explosion of this kind has taken place.

The CHAIRMAN: I should also like to know how the casemates are to be ventilated, for we know the difficulty of getting men to work in places where there is little or no ventilation; and also, as each gun-casemate has its own magazine in the casemate immediately under it, how is that casemate-magazine to be lighted, ventilated, and preserved from explosion?

Admiral Lord DUNSDAY: Perhaps Mr. Scott Russell will kindly explain what seems to me at first sight a difficulty, but which is probably no difficulty whatever in the mind of an engineer. Mr. Scott Russell proposes to interpose between what we may call the two skins of the ship—the armour plates. Now, as I conceive the building of an iron ship, the two skins are here and there connected together, and that connection gives them very much of their strength. So far as that place is

concerned where the armour plate is put in, it appears to me that the two skins will be separated. That is to say, I believe the lecturer did not propose that the armour plate should form any connection whatever between the two skins. I see I am right in supposing that the plate is not to connect the two in any way, therefore, as it appears to me, the two skins are separated, so far as that plate is concerned, without any of the usual strengthening pieces to keep them together. Probably Mr. Scott Russell will also explain whether, as might suggest itself to some people, there is not a loss in presenting to the enemy ordinary plate iron as the *pièce de résistance*, instead of the armour plates. As it is now, the enemy's shot will come into contact with the armour plates; under the proposed plan, the shot are to strike upon the ordinary iron plates, or possible iron plates. I think I understand the lecturer to say two or three thicknesses together, but still, of course, they would be a frail protection against shot. Those are two things that no doubt come within the knowledge of an engineer, but which, to a lay observer, seem to present a difficulty. There is another point of naval engineering of which I do not pretend to know anything at all, but in diagram III one sees that whereas the midship portion varies 100 per cent., one being 100 feet, and another 196; in every case the run and the bow preserve the same length. That, of course, runs a little counter to one's ideas of naval symmetry, but I suppose there is an answer to that, and no doubt the lecturer, when the time comes, will favour us with it.

The CHAIRMAN: As Mr. Reed is present, we shall be very happy to hear any remarks he may wish to make.

Mr. E. J. REED, C.B., M.P.: I really am unable to respond in any manner, such as I could wish, to your kind invitation, after two hours' sitting in a close room on a very hot day. If the discussion is adjourned, I shall then be very happy to take part in it; but the paper has so many points with regard to which I must respectfully differ from the distinguished lecturer, that I should not think it fair to him or to myself to enter upon a discussion unless one had a reasonable opportunity for stating the contrary view.

Major-General ALEXANDER, Royal Marines: I should like to be permitted to ask the manner in which the lecturer proposes to protect the guns within the casemates from diagonal fire. I understand perfectly it is proposed to protect the guns and gunners from direct fire by armour plates of certain thickness, but I was unable to catch the modes in which the guns and gunners were to be protected from diagonal fire, which fire, I apprehend, would be as dangerous to the efficiency of the vessel as that which would be absolutely direct. There is one part of the lecture which we have just heard, that deserves special attention, and that is where such stress was laid on the great necessity for organising and localising not only our colonial defences, but the shore defences of our own country. For if we reflect upon this question, I think it will be found that everything of the kind resolves itself into a question of money, and if we leave until war breaks out, all the organisation that becomes necessary for this particular kind of defence, an enormous amount of money will be necessary and at the same time the work must be inefficiently performed. I am interested in this matter, because some fifteen years since I, in a humble manner, endeavoured to bring forward that particular question, and to show the desirability of separating the coast defence of this country and the colonial defence from the system of a sea-going navy. It has always appeared to me that the necessity exists of having very large vessels, in order that certain sea-going qualities may be obtained, and that a certain power of coal-carrying also should be gained, both of which are utterly unnecessary in a coast-defence vessel. But by organising a special fleet for that purpose, we are able at once to arrive at greater speed, greater defensive power, and greater gun power, and at the same time we are able to separate the organisation, and have a force of officers and men totally apart from those required for more special service on the ocean. I think that is really one of the most valuable parts of the paper. Perhaps it is that I am less capable of entering into the construction of the ship proposed, and of seeing the many valuable points in connection with it.

Captain PRICE, R.N., M.P.: The lecture we have all listened to with so much attention has travelled over such an innumerable range of subjects that it is quite impossible for any one person, within a very short space of time, to reply to more than one or two of the different points. I think the point above all others which

Mr. Scott Russell has dealt with, and very rightly, is the irresistible power of the ram ; and I should like to say one or two words about that. I think that the shape which he gives to the bow of his vessel is not one that is unanimously accepted in the service. The prevailing feeling, I think, at present is that the bow which he has discarded—the snout under water—is that which is generally preferred. But he, as a ship builder, tells us that he does not think it is a safe form, and he has given us his reason—that he thinks it can be easily wrenched off. I hope Mr. Scott Russell will not think it is a personal remark, but I was going to say the line he generally takes is this, that he comes here as a ship builder speaking to naval officers, and he says, "If you only tell us what you want, we can do it for you." My point is this, if it can be shown that naval officers prefer that particular kind of bow which I call the underwater snout, I have no hesitation in saying that Mr. Scott Russell, on his own showing, and other ship-builders, can build a vessel in the particular form that I say we want, and without any danger to the structure of the vessel. That is my point. Now, I just want to say, in one or two words, why I think that form of bow is to be preferred. Taking Mr. Scott Russell's own diagram of a ship, of the bow of the vessel that is to attack that ship, is something approaching to a straight line or slight curve, it is very obvious that if this vessel happens to be rolling a little towards the ship that is attacking her at the time she is struck, she will strike a portion of the vessel very likely above the water-line, and will not run the chance of damaging her under water half so much as if the ram bow of the vessel formed a line somewhat similar to the section of the vessel that is to be struck. There is another point. We cannot always assume that the blow struck will be sufficient to sink the vessel. That depends a great deal upon the way the vessel is built, but it may do her a considerable amount of damage. It may damage the vital portion of the ship, and I want to ask where are the vital portions ; are they above the water-line, or are they not rather below it ? If the ship is struck in any part under water, the chances are not only that a very large hole will be made, but that the engines might be displaced, the boilers might be burst by the concussion, and certainly such damage would be done to the ship as that it would be rendered *hors de combat*. One other little point in connection with that. Naval men are trying to find some means of quickly stopping the rent made in the side of a ship by the blow of a ram. It is very necessary, of course, that that should be done, and a certain amount of success has attended the effort of naval men, both in our own and in foreign navies. Now would it not be very much easier to stop a rent so get-at-able as one would be above the water-line, than to stop one very much below the water-line, where it cannot be so easily got at ? Those, I think, are the points deserving attention in the ramming bow. Another very important point that the lecturer touched upon was that of gun-boats. Now that is such a large subject that I won't go very much into it, but I wanted to make one remark about the power of directing those boats. Mr. Scott Russell and others have advocated that, in certain cases, with small gun-boats, it might be as well to dispense with the ordinary gun-carriage and the training power of the gun, and to build the gun, so to speak, into the ship. I do not think that that is a bad plan at all ; but I would say in the navy, as far as I have seen, there has not been sufficient attention paid to the power of directing the fire of the guns, not from the gun itself, but from some of the points of the ship. It is a very difficult point indeed, and it is one I am not quite sure whether I might not say should be taken up by the constructors of ships in conjunction with gunnery men. Then as to the vertical fire. Mr. Scott Russell raised a smile in one or two quarters when he mentioned that, and so far as the sketch on the board is concerned, where we appear to see a gun-boat shelling with vertical fire a ship broadside on to her, I think it would be quite a useless expenditure of powder and ammunition. But there is one way in which I think vertical fire might possibly be of use, and that is where a ship is running away from a superior vessel. We cannot arm all our vessels with mortars, because we expect that they will be running away, but I think it is the only case in which vertical fire from one ship against another can possibly be of any use ; and the reason, I think, is when one ship is chasing another, you can get the range very much nearer ; it does not alter very much. We all know the familiar expression that "stern chase is long chase," and when one

vessel is chasing another they are both brought much upon the same line. The direction does not vary much, but, more important than that, the distance does not vary so rapidly as it does in any other position that the ships may be in. I was very much astonished to hear the lecturer rather appear to pooh-pooh the power of the torpedo. I think, rather, we ought to make up our minds, and I am sure we have had quite lessons enough, that the torpedo is a very fearful instrument of destruction, that it is by no means such an easy thing to defend yourself against as the lecturer seems to think. I am not alluding to what we have heard lately in the Danube so much as to what occurred some years ago in America. We had ample illustration of the power of the torpedo in the American war. I am speaking without book, but I think there was something like thirty or forty vessels destroyed by the torpedo. I was only the other day reading a book on submarine warfare by Mr. Barnes, an American, and one sentence came upon me with great force. Speaking of offensive torpedoes, he said that throughout the whole of the war, events went directly to show that in no single instance where a torpedo boat was sent to attack other vessels did she meet with failure by reason of the guns of the enemy. It was the case that in one or two instances torpedo boats were badly made, and they sank themselves. We know one submarine boat was sent out, which sank herself two or three times, and all the crew; but in no one instance was a torpedo boat sunk by the guns of the enemy that she was sent to attack. That is a very important thing. I believe myself, that it would depend upon the pluck and nerve of the operator. Of course torpedo boats will only attack at night, and if we have only the big guns of the vessels being attacked to depend upon, it is quite impossible, or, practically speaking, it is impossible, that you could sink a torpedo vessel, however well you might see her, before she got within range. All this shows me that what we want in the navy to decide on this point really is experience, and experience means money. By experience I mean experiments. That is a thing we have not had enough of, simply because we are not allowed enough money to conduct these experiments. If we only saw by a vast number of experiments what was really wanted, then we should be in a position to come here, as naval men, and inform Mr. Scott Russell and other eminent shipbuilders and artillers, exactly what we want, and I have no doubt they would be quite able to carry out our requirements.

Commander CYPRIAN BRIDGE, R.N.: I should like to say a few words, not with reference to the scientific part of the questions raised by Mr. Scott Russell, but upon what I may call the naval part of the questions. I take it, and I have no doubt many of my brother officers do, that a man of Mr. Scott Russell's eminence and well-known reputation, coming here to lecture chiefly for our benefit, is a very high compliment to a service which, judging from the newspapers I have seen since my return to England quite lately, has not had very many compliments paid to it. Great as is the advantage that undoubtedly accrues to the naval and military service from the fact of such eminent men coming to lecture in this Institution, still there are some compensating disadvantages; and one compensating disadvantage is this, that it very often goes abroad from this Institution that things are not going on well in the Navy. About the Army I know nothing. What really is the case? For instance, there was one thing which I made a note of, and I am quite sure nobody will be more glad to hear it than Mr. Scott Russell; and that is, he spoke about the concentration of fire. My honourable and gallant friend Capt. Price spoke also about its not being sufficiently attended to—about the concentration of the fire of a single ship being in the hands of a single individual. Now Captain Price is a far greater authority than I can pretend to be, and he knows, even up to the time he last was afloat, considerable attention was being paid to it, and considerably more attention is being paid to it now; and I mean to say the Captain of a ship has now absolute control of every gun in the ship. He can direct that every gun be laid right a-beam or on any bearing, and at any elevation that he desires, and he himself can fire every gun in his vessel simply by pressing down his little finger, he being in such a position where he can see the enemy's ship, and where no single individual on board ship except himself can see the enemy's ship. Not only is this the case in the large ironclads, but in the gun-boat of which Mr. Scott Russell spoke, and which he suggested should be actually the gun-carriage, so that the gun should require no carriage of itself, but simply the boat in which it is embarked—that, to my certain

knowledge, has been in existence—the system of firing the gun and directing it—for three or four years. When I was in the "Cambridge," under the command-in-chief of the Chairman, one of the lieutenants there had devised a scheme for steering the vessel, and directing and firing the gun by the command of one individual above. And that entered into one part of the regular course of instruction, and was carried out every day that that gun-boat was sent to sea; that is, at least, four years ago. From leading articles, very often founded upon lectures and discussions that take place in this Institution, it often appears that even people whose business it is to look after the service of the country do not do so as satisfactorily as they might. I was reminded of this by Mr. Scott Russell's allusion to gun-boats. Now, I doubt whether there are half-a-dozen people in this theatre who can be aware of the efforts that are being made to put the country on a proper footing—with reference to the defence of its colonies—those members of our empire which are just as much members of our body politic as our limbs are of our own body—I say I doubt if there are half-a-dozen people in this theatre who are aware of what is being done at all events by the present government (I cannot speak of the last government, I only speak of my experience in the last year or two, and I have no means of information which is not open to all the world), that there are at least two colonies some thousands of miles apart, for which a special class of gun-boats has been constructed quite twelve months ago. And in one colony, the land on which the stores of these gun-boats are to be deposited, was purchased, or made over, by the Colonial Government to the Imperial Government, at all events in 1876. So that shows that we are not quite so badly off with regard to the people at the head of the service doing their duty towards the colonies, as we are supposed to be. I quite agree, and no doubt many others will agree, with Mr. Scott Russell in his estimate of the power of the torpedo; and he applied a very correct epithet to it when he called it a "bugbear." I think Captain Price a little misunderstood him when he assumed that the lecturer thought that that vessel which is shelling the large one literally upon all sides, would be destroyed by the power of her guns. I take it he meant that she was to be destroyed before she got within range of the guns, and although those numerous losses did actually occur in the American war, still we must remember how it was that they did take place. One occurs to me, that of the "Tecumseh," in Admiral Farragut's action at Mobile, where nearly 200 men were lost. I think that is the number put down in the "butcher's bill," returned after the action. That vessel was destroyed, as I was told, by two American officers who took part in the engagement, because the Captain of the "Tecumseh" chose to go exactly where he was told not to, where Admiral Farragut was perfectly aware that if the vessel did go, she would be blown up. I think that tends to corroborate the view taken by Mr. Scott Russell of "Sarve 'im right!"

Major BAYLIS, Q.C. : I rise to move the adjournment of this debate. We have had a most interesting lecture, and we are most anxious to hear what Mr. Reed may have to say about it, and therefore I think it would be well if, at this stage, the discussion were adjourned.

The motion having been seconded by Captain SCOTT, R.N., the meeting was adjourned to Tuesday, June 12th.

ADJOURNED DISCUSSION.

Tuesday, June 12th.

ADMIRAL OF THE FLEET SIR HENRY J. CODRINGTON, K.C.B.,
in the Chair.

Major BAYLIS, Q.C. : It is my privilege, Sir, or rather my duty, to speak first, on one of the most important subjects connected with the naval supremacy of Great Britain, viz., the best ships to be built, and secondly the best mode of destroying the best ships of the enemy; and I feel naturally diffident, amongst so many distinguished scientific persons and naval and military officers, in saying a word on the subject. On

Friday last I came here as a listener, but I was so delighted with the lecture which was read and illustrated by Mr. Scott Russell, that seeing so short a time was then left for that which is most important, the discussion on the lecture, I moved the adjournment. With reference to torpedoes, I think Mr. Scott Russell will admit that they are very dangerous implements of warfare, and that we must take great care that they do not run against our best ships, and we must take the best means of running them against our enemy's ships. He said he considered they were rather a scare, that is that it only required vigilance to get out of their way, but still they are (as is admitted by all) a most formidable means of destruction to the largest and best found vessels that ever sailed on the ocean; that being the case, I am afraid there will be found persons rash enough to take command of a torpedo ship if there is an object to accomplish. By your indulgence I will now also venture to mention a few topics which occur to me. The subject of gun-boats has been to myself a matter of very deep interest for many years. I recollect very well when Mr. Laird built some gun-boats for the Dutch Government, useful boats in shallow waters, boats that could not be approached, and could easily run out of shallow harbours, and boats that were a very great protection to the coast, probably much more so than those batteries which have not the power of locomotion—it always seemed to me that gun-boats were what we ought to have. I ventured then to consider that they were indispensable, or would become so, and still think so. Now we have heard from our able lecturer that he recommends gun-boats, and he recommends that there should be two guns, one at each end; and that there should be large vessels which should be speedier, should have stronger bows, be handier, and also capable of endurance. He has suggested to us that the more endurance a vessel has, in other words the more fuel she can carry, the longer she can last out, the more she can play with the enemy. With regard to the gun-boats he has made an excellent suggestion that we should have gun-boats in different parts of our colonies available for the protection of their coasts, and ready to assist the larger vessels when they go there. There is a curious fact which has happened, and which will be no doubt the subject of discussion in this institution, that although in the first instance the Russians were successful off Ibraila against the Turkish monitor on Saturday last, they made, it is stated in the newspapers, a similar attempt with six launches, and were not successful, by reason it is said of the advice given by Hobart Pasha in placing boats with chains round the monitors. I would draw your attention to one fact, that although the attack was repulsed, one vessel did, I understand, strike the monitor, but not in a vital part. It comes, therefore, to this, that it will require, in addition to the various onerous duties of the commander of a vessel, a further increased vigilance to encounter this secret foe—a foe the worst of all he can encounter. I know the heart of a British sailor exists in a British commander, that he would fight an enemy openly, he cares not whether he takes his ship against a fortification or against a ship double his size, but what he does fear is the torpedo, and, therefore, the subject of the torpedo, and the way to avoid them, is one of the most important questions of the day in connection with the subject matter of this lecture, "The development of our Modern War Fleet." We had a lecture lately from Mr. Donaldson on that subject, and I see also that the subject announced by this institution for the next Naval Prize Essay is one analogous to the present, viz. "Great Britain's Maritime Power, how best developed as regards—1st, fighting ships—2nd, protection of commerce—3rd, naval volunteers, or supplemental force—4th, colonial and home defence; the classes of armament, and description of the vessels needed, and the organisation required to secure a powerful and economic Imperial Naval Force." Having made these remarks, I hope that I shall have accomplished my object by a revival of this important discussion, though I am afraid you will consider I was rather rash in coming forward as I did in the presence of so many distinguished officers and men of science, but whom we now hope to hear.

Mr. JOHN A. WELCH (Naval Architect to the Colonial Department): I should be very glad to make an observation or two on the subject of gun-boats. It may not be uninteresting to this meeting to know what has been done by foreign navies with regard to the supplying themselves with heavy-armed gun-boats. I will first allude to two small twin-screw gun-boats that were built to a Chinese order in 1875. They were vessels, improvements on the steam-launch class which have been

in use in our navy, and to make them better sea-going boats they were constructed 87 feet long and 26 feet beam—253 tons O. M.—drawing 6 feet of water when fully loaded. They were armed each with steel gun of 16 tons, 10-inch bore, and threw the same weight of projectile as we throw with our 18-ton gun. These little boats were tried under steam, and developed 200 indicated horse-power, attaining 8½ knots. They were remarkably handy, making their half-circle in less than a minute, which is remarkably good. Those boats were to be sent to China, but the guns were not sent in them. They had their carriages and slides and 300 rounds of ammunition, preferring to make up the weight which could be carried, with coal. They proceeded on their voyage under sail and steam, and, without stopping on the way, they arrived with great success at their destination, having been navigated by officers of our own service. These were the first small vessels of that type that had crossed the sea, or had made such a journey. The next class is a larger class of vessel, built to the order of the Argentine Government. Four of them were built in this country. They were 105 feet long, and 30 feet beam, 416 builder's tons, with a draught of water of 7 feet 6 inches when fully equipped. These were the first vessels built to take a 26½-ton gun. They were also tried under steam, and realised 9½ knots with 400 indicated horse-power, and also proved remarkably handy—that was their best feature. There was a stipulation that there should be so many rounds fired off from the heavy guns, and six rounds were fired at sea. The vessels stood the test remarkably well, not the least damage being done; a point on which some doubts had been entertained. They proceeded under sail and steam, and arrived at their destination, Buenos Ayres, having started from here in January, 1876. I mention that to show that small vessels, heavily armed, have been built for foreign governments, and have arrived safely in a foreign country, showing that they must, to some extent, have been sea boats, although not of the best type possible. But, taking the whole of the circumstances into mind, they were remarkable for their handiness, for the power of working and fighting heavy guns, retaining the original idea, I think, of making the vessel virtually the gun-carriage. The broader the boat was, the steadier she became, and altogether I consider they were a great success. I also wish to show what has been done in that respect since gun-boats were introduced into the navy of the steam-launch class ten years ago, and also the "Alpha," "Beta," "Gamma," and "Delta" gun-boats lately built for the Chinese Government that we have heard so much about since last January. I have had great pleasure in listening to the paper, and though it is almost presumptuous in me to offer any observations, still I think that in a great many respects we have fulfilled Mr. Scott Russell's ideas, although some of the ideas have yet to be fulfilled by a vessel, I believe, that has not yet been designed. Mr. Scott Russell stated that he would like to have a 15-inch naval gun 15 feet long. You will observe we have already fitted 10-inch guns and 11-inch guns in the small gun-boats I have described. He would then make those gun-boats strong in the bow, so as to be practically a bow of armour. With regard to that, special care was taken in the vessels for the Argentine Government. The gun was a disappearing gun, and of course it had to fire over a part cut away to allow the depression to be obtained. That was made of thick plate; and this expedient was adopted: that whereas the beams would have the edge strips under, as a usual rule, they had them on top, and of an extra width for increased strength. We doubled the beams under it, and between those beams and under them fitted a strong iron girder, so that should those vessels be used as rams they would give a good account of themselves. Mr. Scott Russell mentioned that there should be no means of adjusting these vessels except by the officer in command, who should be able to do so by the rudder alone. That point was also carried out. The officer in command could go under shelter. A covering house was built, fitted entirely for the purpose of manoeuvring the vessel, so that everything was done under cover.

MR. SCOTT RUSSELL: You mean the gun is manoeuvred by the rudder.

MR. WELSH: The gun itself is not touched; we manoeuvre the vessel in order to get the training, we make the vessel the gun-carriage generally. So that that suggestion has been carried out. Mr. Scott Russell also alluded to the one big bore gun in the bow, and said that the vessel must be handier than any boat in the service. I believe that advantage was also claimed for these vessels. Their handi-

ness was remarkable. On one occasion we had the Director of Naval Ordnance on board, and he expressed himself delighted in that respect. He took command, and said "I want to strike a certain object," and he saw in what way the vessel would be obedient to his will. I fully agree with Mr. Scott Russell that in some respects we have not paid as much attention to these gun-boats as we have to the larger ships. He alluded to a duplicate-gun gun-boat—so I understood it—that is with one gun in the bow and one in the stern, exactly the same size, and the boat to go as fast astern as ahead. Now, if Mr. Russell meant a paddle vessel, his paddles would be too much exposed to think of having a paddle-wheel vessel to do his service; and with regard to screws, it would be impossible to get screw vessels that would be able to go astern as fast as to go ahead; so that Mr. Scott Russell must have a new design in his mind in making that observation. I quite agree with him that two kinds of vessels are required for the Royal Navy. We want to have fast vessels to take up a position; and we want also handy vessels, so that with two classes of gun-boats we should be well suited in that respect for all the service that may be required of such vessels, and I hope and trust that out of this discussion that conclusion may be arrived at.

Admiral Sir SPENCER ROBINSON: I regret very much the absence of Mr. Reed,¹ as I should have liked extremely to have listened to any observations which he might have made on a subject which, I know, has occupied a great deal of his attention, and if he had been here and had been disposed to speak upon the matter, I should not have ventured to offer any remarks myself, notwithstanding the great interest I feel on the subject. I have always been in all these matters much more of a learner than a teacher, and I confess that from no one have I learnt more than I have from Mr. Scott Russell. I had the misfortune of not being able to be here when his paper was read, and I do not feel in any way qualified to criticise any of the remarks he has made. I should only wish, from the little knowledge I have, to supplement in a few words some of the observations which he made, as I feel perfectly certain that though I did not hear all that he said, the general tenor and substance of his remarks has been known to me for several years. He always has started with this one remarkable assertion or proposition, that, if what naval officers want to conduct a naval action, is known to the naval architect, the naval architect can invariably supply them therewith. In that proposition I need not say I must entirely agree, and it is especially with a view of explaining or throwing some little light upon the wants, as I consider them, of naval officers, in carrying out a naval action, and of what should constitute the navy of this country for carrying out a maritime war, that I venture to speak a few words. What I think, what I know Mr. Scott Russell thinks, and I have seldom heard any thoughtful man express any other opinion, is this: Great Britain, to carry on a maritime war, not only wants single ships, but she wants a fleet, and the construction of the fleet is the great object that the naval administration of this country ought to have in view, and this principle I hope that all those who wish well to their country, or can influence its naval administration in the right way, will take also into their most serious consideration. A single ship, however perfect, let it be the "Inflexible" or let it be the smallest gun-boat of the Alpha class, any single ship cannot in any way whatever represent the necessities of this country in naval warfare, nor can it represent the weapon which a naval officer on general service will have to use in destroying those ships of the enemy it may be his duty to destroy, or in making those attacks upon an enemy's fleets, fortresses, or positions, which it may be his duty to make. The country wants ships which shall in their various ways perform those services of assault and defence through which a naval warfare must be carried on. When I come to reflect upon how naval warfare is to be carried on by this country, I admit the subject is so large, the features are so enormous, and present so many sides and difficulties, that within the limited time allowed for any one of us to speak in this Institution, or indeed in any verbal discussion whatsoever, wherever it may take place, I think it would be utterly impossible to exhaust the subject, to suggest everything that should be suggested, and to meet all the arguments against such

¹ Mr. Reed, owing to a previous engagement, was unable to attend on the day fixed for the Adjourned Discussion.—*Ed.*

and such propositions, which would naturally occur to those who heard the subject, and whose minds were fixed solely or particularly on some of the necessary points of naval warfare. But we should all agree in this, that a fleet is, in fact, what we want; that a fleet must be composed of ships of various classes; that no single ship alone will be adopted for naval warfare under the circumstances of the development of science, and the means of destruction that now exist, and that every ship must act in combination with other ships; she must be the unit round which other ships congregate, and when we have got the ship and her satellites in attendance upon her, of the right size, sort, and stamp, then we have got the one unit of force capable of doing its duty in what may be called single action. But I think if you cannot admit so much as that, you must at least admit this, you must say that the whole fleet of Great Britain must be so constructed, that each unit of its force shall be composed of ships of various classes, attended by others, larger or smaller, as the case may be, and that the concentration of these ships and their attendant satellites will alone constitute a fleet calculated to destroy anything that may come upon the surface of the sea. It must be remembered that the whole object of naval war for Great Britain is not, for instance, to go to anchor in a river or a bay and there remain, exposed to the attack of torpedoes and of electric mines, and various other destructive agencies, though that is one portion of the duty the British fleet may have to perform, and we know the means employed for destruction in the case of a ship at anchor are extremely formidable, and can only be met by an equally formidable use of the same sort of attacking force as the ship is exposed to. No one can doubt, for one single moment, that when large ships are compelled to anchor in roadsteads, or rivers, or narrow waters, they must be attended by vessels of the Thornycroft type, we will say, or of any type that will bar the advance of the insidious torpedo, whether of the Whitehead or ordinary type, or any other engine of destruction that acts at a distance over or under water, and be ready to destroy them; while the large ship will be there to protect and co-operate with her satellites to overcome the serious opposition of batteries and heavily armed ships, to aid in a landing, or to prevent the assemblage of troops, destined, perhaps, to threaten our various possessions. I said it was impossible to discuss how naval warfare should be carried on within the limits of any speech that any man could make, or even within the limits of a very long lecture, and I have experienced gratefully the patience and temper with which this audience will always listen to remarks upon the subject, but I have some sort of conscience, and I cannot for one moment think of inflicting upon this distinguished audience the very many important remarks that occur to me, as to the way in which this naval warfare must be carried on. I have only indicated, in support of the very able lecture Mr. Scott Russell has given us, how necessary for our purpose it is that we should have not single ships, nor ironclads, nor gun-boats only, nor unarmed ships only, but that we want a thorough and comprehensive navy or fleet; but as to the parts of that navy and the details of the ship composing it, I really would not trouble this meeting with saying what they should be. As a general scheme there must, no doubt, be large and small ships, swift and heavily armed vessels must act in combination with others of different types, to secure the due execution of such services as are vital to our interests as a nation. I certainly cannot overlook this fact. Supposing this country is engaged in a naval warfare, and expeditions are about to leave foreign parts which I will not mention. I will not say anything which could be construed into an offensive remark with regard to any foreign power, but we will suppose that it suited some naval power to make an attack upon any of our dependencies; that attack must be frustrated, and can be only frustrated by having ships that can be at sea, remain in the track of those ships that may be entrusted with that expedition, and through the power of our gun, the weight of our armour ships, the speed and coal-carrying power of these large monsters which are so expensive, and which may be destroyed easily, our fleet must have the power to remain in those seas where you may want to fight, where the very existence of this country may have to be decided, and where we may find it necessary, in certain latitudes and longitudes, to repeat, with different weapons, indeed, but with the same results, the glorious actions of the past. For this purpose, your big ships, heavily armoured ships, swift ships, ships of great coal-carrying power, are as much or more wanted than your

gun-boats or torpedo vessels. It is therefore only the simplest idea of not throwing all your eggs into one basket that makes me say: Stand by a fleet, and do not be satisfied with single ships, however perfect. Let that fleet be the point to which you will gather up all your strength to fight that battle which will decide, perhaps, national existence; but for a thousand other purposes you will want all the small vessels, all the swift launches, everything that has been described. It has been sometimes said that the whole navy of Great Britain ought to consist of gun-boats, or torpedo boats, or things of that kind. I am sure this meeting are much too intelligent to approve of such a course, but I have often, in the course of my official life, found that things, reiterated and stated again and again in the columns of a newspaper, weigh upon the minds of those who have to decide how the navy shall be constituted, and how naval warfare ought to be carried on. I say it is absolutely indispensable for this country not to be led away by the false theories that are continually put before it, but to maintain a fleet composed of large and small ships, powerful and swift ships, and others whose whole power and object should be simply to make a dash with a mine to explode it under the bow or stern of a ship. I do not know whether I have correctly followed what Mr. Scott Russell has said, but as I said before, I have so often heard him urge this point with intelligence, argument, and wit, that I do not think I can have mistaken him. I conceive it is sound in principle, and without in the least pledging myself, or any body who has to act in this matter, to the details Mr. Scott Russell thinks it necessary to establish, in order to obtain what both of us aim at—a powerful fleet, I am certain I am not running counter to what your lecturer has said to you, but am rather supporting his views, and also that those views are sound, and will recommend themselves to the sentiments and to the opinions of all who have done me the honour of listening to me on this occasion.

Mr. STIRLING LACON: This being a scientific meeting, I wish to put myself in order by stating that six years ago, while sitting next to the Chairman, I whispered in the ear of Sir George Sartorius that science had got command of the ship, and that practice and common sense were driven before the mast. I know little of science, but I wish to illustrate, by what has come under my own observation, what it is that I meant by science running ahead of and taking the precedence of practice. When I was in the Baltic I twice passed through the Russian fleet of thirty-three pennants (great and small), which were about to be reviewed by the Emperor on the same day, whom we afterwards met in his magnificent yacht coming from Cronstadt.

When we were three miles from the fleet we were overtaken by a first-class frigate steaming at full speed, with her anchor still hanging from the bows, not fished, not catted, and I ask what would have been thought of this in the old days of pure seamanship? The North German officers, with whom I had a good deal of conversation, appreciated this fact, as I trust it will be appreciated by our own naval men.

Captain R. A. E. SCOTT, R.N.: Mr. Scott Russell's very admirable paper has more distinctly brought before us than has yet been done, the necessity for a large ocean fleet; a fleet which will maintain our empire on the sea, will keep our commercial ships free from the attack of the enemy, and whose duty will of course be to destroy that enemy. Without her commerce, England would be entirely crippled; her commerce is in fact her legs and her body, and it is for the protection of that commerce that we must have a powerful fleet. I think Mr. Scott Russell has done well in separating the ocean fleet from the inshore flotilla for the protection of our own coasts and for those of our colonies; every day the distinction between these two fleets is becoming more decided, and every change which is now taking place is tending greatly to our advantage. With respect to our iron-clads and large cruisers; it would be a very great mistake to place such valuable ships under batteries, for there is almost a certainty that they would be blown up; as their thin decks would be very soon driven in by the plunging fire of large guns. I think this would be a contest in which there would be very little honour to be reaped, in return for the very great deal of danger incurred; in fact more than one vessel might thus be lost without producing any result. Some of you, I daresay, remember the attack made by our wooden war ships on the forts of Sebastopol. It was very good

perhaps as showing what our sailors were ready to do, but what was the result? Our vessels could really do nothing then, but in the present day, against batteries armed with powerful shell guns, our vessels would have no chance of success. England, as regards torpedoes, has really pushed forward the invention of the fish torpedo more than any other power, and in the use of gun cotton she has found the means of protecting her vast shores with certainty. Happily there are on our own coasts a number of intrepid sailors always at hand, and quite capable of handling these dangerous weapons. To do so with success, requires the skill, dash, and coolness, which are the very characteristics of our race, or, at any rate, they were the characteristics of the old Norse kings from whom we are in part at least descended. We have therefore developed the very weapons that could be employed with the greatest advantage, and would fully bring out all the skill and pluck of our fishermen, sailors, and coast population. These men, armed with a few torpedoes, would very soon be enabled to give a good account of any vessels that might approach near enough to bombard our shores. A successful attack would be practically impossible were our very large flotilla of tugs and river steamers capable of acting as rams, torpedo, or gun vessels, to be organised. Now that organisation does not exist, and the only thing that does exist for our defence is the coast artillery brigade, which is not in connection with the coastguard crews and their stations, or with the Coast Volunteers; nor are there any telegraphic communications between the coastguard stations, or with head-quarters. If the enemy were on the coast to-morrow I do not know whose duty it would be to keep him from landing. It would doubtless be somebody's duty to fight him after he had landed; but to but in the organisation for keeping the enemy off our shores we really seem have made no progress. A remark has been made about the discussions in this Institution getting abroad, and other nations becoming aware of our defects. In reply I would say that they know them far better than we ourselves do, for we take the greatest possible care to show all novelties in our dockyards and arsenals to foreigners, thus enabling them to compare these improvements with their own. If I wanted to know the defects of England's vessels I should go on board a German, or some other foreign vessel, to ascertain them by comparison. I will give an illustration of my meaning. Looking over a German vessel at Portsmouth, in company with her commander, I went into the question of her armament and its preservation from deterioration, a subject in which her men as well as officers took the greatest interest. I asked the commander how he managed to keep his gun gear in such capital order, and in reply he said that he cleaned his gun deck with warm water and was careful to keep it dry and to see if the working gear underneath the guns was in good order, and I found no rust whatever upon them. I could not but contrast this with what I saw on board our own war ships—where the men were scrubbing away with sand and water, covering the gun carriages with these and destroying the gear of the slides; in addition to which there were men polishing their cutlasses with brickdust, to the detriment of the gun carriages and gear upon which the cutlass points were rested. Another instance of our backwardness was given to some of us who had the pleasure of listening to Mr. Donald Currie's admirable lecture when he showed that there were no telegraph lines to the Cape; and said, it was not dispatch boats that we wanted, but rather a telegraph, which could send information a great deal quicker. He showed also that although we had some very large iron-clads, still if they got disabled at long distances from England there were no means of docking and repairing them. This serious defect has since Mr. D. Currie's statement here, received much attention. I dare say some of you remember that more than a year since a Government official said in this Institution that the merchant navy was of no use for purposes of warfare—an opinion which being dissented from was afterwards very much qualified. Subsequently we heard that the buying up of the fastest steamers of our merchant fleet would at once enable every port of an enemy to be effectually closed. That was however going to the opposite extreme. But the wise course is, take the merchant navy as it now exists, and for new ships, to use every effort to obtain additional strengthening bulkheads, and those water-tight divisions that many of us think are as valuable in merchantmen as they are essential in war ships. Mr. Scott Russell, in asking for discussion upon his proposed cellular construction, may

say, if naval men will only point out what is required, that then it is sure to be carried out ; but I reply, naval men have continued to insist that the first point to be considered in a ship is unsinkability, and consequently her bottom must be divided into numerous cellular spaces. The torpedo has done much to effect this result, but as you already know, the "fish" is a dangerous weapon to those who use it, however skilfully it may be handled. The fish torpedo will run about 250 yards at 25 knots, but if required to run a longer distance, it must go at a much slower rate. It is propelled through the water by double compensating engines, worked by highly compressed air, and though the lecturer does not consider it a very formidable weapon for ocean warfare, it will run about a thousand yards at a slow speed. At the end of seven or eight hundred yards, however, it commences to diverge from a direct line. I think there is a source of danger in the way in which those torpedoes are (as I am informed) straightened when they are a little out of truth, as there is a tendency in metal to return, after a time, to its original shape. I think, therefore, it will be found that torpedoes which do not go accurately when first tried in the canal, and have to be straightened, will, after being some time on board ship, resume their original curved running on being discharged.

Besides the fish torpedo, there is the spar torpedo, which from its simplicity and the large charge it can carry, is a very valuable weapon for general use.

Our merchant shipping carry at the present time some capital life boats, and any of these, or the lighter gigs, could take one of these spar torpedoes, and if the fellows had coolness and pluck, and their ships fired off a little powder to mask the direction in which they were going, there is no doubt that the boat might dash in and, as a rule, give a very good account of their enemy. As bearing on this point, I may tell you of an attack upon the "Excellent" just as it was told me. Captain Singer was in command of the party on board, and one of the gunnery officers, the commander, I think, of the "Vernon," was leading the attacking party, using the spar torpedo. The crew on board watched and waited, keeping the strictest look out, having boats patrolling all round their ship ; these boats pulled backwards and forwards and continually spoke each other. The wind was from the "Excellent." The skilful officer in command of the attacking party looked out for his opportunity, and after a time got to know exactly when the patrolling boats neared each other, and then, seizing his opportunity, he dashed forward, ran his boat past the patrols and struck the "Excellent" fairly before any of the defending party could cut him off. In this case there was the gunnery ship herself watched in every way, and yet with her skilled crew and all her appliances she could not prevent the spar torpedo from being run against her. If a vessel so ready could not prevent this, what fate might be anticipated for the ironclad that foolishly ventured close to a guarded shore or came near an enemy's port ? We must, in my opinion, no longer think of taking ironclads into narrow waters ; the time for this, I think, has altogether passed.

There is another weapon which I believe there will be an opportunity in this theatre of your shortly hearing something about, namely, the rocket. I will only say that this rocket can be made to go under water, carrying at least as large a charge as that of the fish torpedo, over which it would have the advantage in cost and in simplicity, and it can be easily carried in any vessel with comparative safety. Before addressing myself to the details of Mr. Scott Russell's plans, I wish to add that I have known a great many good effects to result from our discussions here. I do not quite like to mention the instances, although some have resulted in valuable modifications of various ships and their armaments. I venture to recall to your mind that the Duke of Somerset and others of our highest officials have spoken very strongly of the value of this Institution, as affording a means of examining and discussing important inventions, &c., and thus enabling our Statesmen to make use of the information for the public benefit. This benefit was apparent in the case of the guns with which we were going to arm our navy some years since ; I allude to the breech-loading guns. There was a lecture given here, followed by a discussion, the Duke of Somerset being in the chair. It was said by those who supported the breech-loader, that all the navy wanted in addition to the breech-loader was a gun or two that would penetrate armour plates. If you turn back to the discussion on the subject, you will find that it was strongly urged that the Armament of the Navy should mainly consist of guns

more powerful than the breech-loaders, and a short time afterwards the 100-pounder smooth bore guns were adopted, and subsequently heavy rifled guns, muzzle loading; and to the Duke of Somerset we are greatly indebted for the improved iron gun carriages now on board our vessels, carriages which have been, I believe, copied by all other nations. A great deal has been said about the superiority of our guns. Now in China the other day, as I was told, the French admiral said to the English admiral, "You think your guns are better than mine, come to sea with me for a couple of days." Our admiral replied that he would go with pleasure if he might take his gunnery lieutenant. This being agreed to, he was on the French ship during her two days' firing and exercising. The guns were fired at from two to four thousand yards with the greatest accuracy; and I suspect that on his return our admiral made rather a strong report on this subject. As the costly armour of our ironclads is put on to withstand an enemy's guns, we on our side ought to have the very best weapons we can get, so as to destroy his armour and sink him as soon as possible. With regard to the 36-ton gun which Scott Russell advocates, we have heard that a number of gun-boats have been built lately, each to carry three 64-pounders. I do not know what stations those gun-boats are intended for, but the Chinese have the "Alpha," "Beta," "Gamma," "Delta," armed with 38-ton guns, and therefore capable of opposing any ironclad that might come to attack their ports. How we are with our lightly-armed gun-boats to beat off heavy war ships, I cannot quite see. With respect to Mr. Scott Russell's mode of mounting his standard 36-ton gun and making the vessel the means of pointing it, I feel quite sure he makes a great mistake. I have tried to point guns by means of the helm, but always found that just as the man was going to fire, the ship gave either a slight roll or lurch, or else a swing, and disturbed the aim. To point and fire a gun fixed in the bow, she must keep advancing, otherwise she cannot fire. To remedy this defect in part our 18-ton gun-boats are arranged to give their guns 25 degrees of training on each bow, but that is not enough, because the gun-boat can only fire when it is approaching an enemy. What you should do is to make any new gun-boats a little larger, so as to admit of their heavy ordnance being given a wide arc of training, using appliances as simple as possible. I quite concur with what Mr. Scott Russell says as to simplicity, and I think I can illustrate its value and show that I have not been wrong in asserting that all our guns ought to be worked on one uniform system and by the simplest machinery. We can work guns up to fifty tons weight by hand appliances, but I do not think we can go beyond that with advantage; in fact I think properly rifled 40-ton guns would be fully equal to doing our naval work. The 38-ton ship guns are now being worked by hydraulic machinery alone; although there certainly has been some attempt to work them also by hand. In the "Thunderer's" after-turret there are two 35-ton guns mounted and worked on the hand-machinery principle, which would never have been carried out but for the support of the former Controller of the Navy. In the foremost turret are two 38-ton guns, but if anything happens to their machinery the crew would have to get outside the turret to load. How the different operations are to be efficiently performed in action, should the hydraulic machinery get out of order, I cannot tell. You may however say that the hydraulic machinery will not get out of order; possibly not. There was a great hurry a little more than a fortnight since to get the 80-ton gun to Shoeburyness. There it lay on the Arsenal wharf, and there was the magnificent 100-ton hydraulic crane ready to lift it, but unfortunately the crane would not move. With all the talent of the Arsenal, for four days nobody could discover what was the matter, so the gun lay a fortnight before it was lifted from the wharf into the barge alongside. That little incident shows how dangerous it is to trust mainly to gear in which the failure of a valve will at once place the gun *hors de combat*.

Mr. Scott Russell says he wishes to have everything as simple as possible, yet that he will muzzle-pivot his proposed 36-ton gun. To muzzle-pivot you have to lift the whole weight of the gun by the breech. Has Mr. Scott Russell considered the enormous power that is needed to lift continuously and rapidly through small spaces a 36-ton gun; does he know that it would take a height of 14 feet to give the usual elevation and depression with the 36-ton gun, and if the slightest thing goes wrong with this elevating gear he could not use his gun at all; but supposing the gun to

get a heavy shot in the muzzle, then in all probability the concussion would break the lifting gear, and the breech of the gun would fall down. Mr. Scott Russell says that he would make the ship the gun carriage, and would keep broadside guns pointed abeam ; but just as the enemy was passing abeam, there might be no opportunity to fire, either your friend might be in the way, or your own vessel might sheer off a little and disturb the aim. You would not have nearly enough training in these narrow casemates. You would also lose the opportunity of firing to the best advantage in a sea way. If you can train your gun so as to be able to point forward or aft, you would be enabled to place your ship so as to be tolerably steady instead of having to fight when rolling heavily in the trough of the sea. Mr. Scott Russell appears to have some doubt on this point ; but how does Mr. Scott Russell propose to arm his cruisers ? He intends to have a bulkhead forward and another bulkhead aft, so that the crew would have no protection abeam. I think even on his own showing this arrangement is wrong. Mr. Scott Russell speaks also of having lighter guns to fire only ahead. I think, as a general rule, that a ship advancing to ram would not fire ; the time she would fire her guns would be after having attempted to ram, perhaps while rubbing along the side of her enemy. I doubt very much the value of letting off broadside guns by electricity, for I think you are very likely to fire all your broadside guns at the wrong moment. I have conversed with a great many practical men on this subject, and I have considered the question carefully myself, and so far as I can gather, when good practice is made is, when a good captain of a gun is looking along one of the centre guns ; but when the captain of the ship placed above the battery gives the signal, he is very likely to mistake the time of the ship's rolling, and to miss with every one of his guns. With respect to Mr. Scott Russell's mode of plating, some of you who have watched the recent experiments at Shoeburyness have long known that our cast-iron projectiles generally crack, or break up on impact. Recent experiment has shown to what this is due ; when the shot is cast in sand, the head is cast in an iron mould and chilled, consequently its particles are in a very strained condition. Hence, recently, in passing through a 4-inch plate, the projectile broke up ; falling against a 10-inch plate it failed to penetrate. This projectile would, under ordinary circumstances, have penetrated not only a 4-inch plate, but a second, third, and fourth 4-inch plate if teak had been interposed between the plates, because the wood would have absorbed the vibration, and placed the shot in a condition to penetrate the next plate. There seems no doubt that the shot are destroyed by vibratory reaction from blows, and Captain Grenfell recently brought to notice the fact that when steel plates were fired at at Spezia they did not crack at first, but a singing noise was heard, and soon afterwards the plates cracked from the vibration. The hardness of the steel seemed at once to stop the projectile, and the tremendous blow broke it up entirely. There is a very valuable principle shewn by this experiment, viz., that if we have a strong plate, say four or even two inches thick, it will crack the cast shot, and then if we add an inner plate of eight inches thick, and place it at four or five feet on the inside, it will stop the shot altogether ; and with this distance between the inner and outer armour plate, you might have a torpedo striking the outer part, and exploding upwards between the plates, and do no more injury. That is one possibility of using armour in the future ; and it seems to me that if we cannot do something towards the improvement of the system of putting on armour, we should not go on building large ironclads which are so difficult to keep at sea, and so excessively costly in their repair.

Captain GARDINER, R.N. : I should like to ask Mr. Scott Russell if he will kindly tell us how he proposes to give light and ventilation to his casemates.

Captain J. C. R. COLOMB, R.M.A. : I wish to make a few short remarks. With regard to the casemates, I presume, though each of them has a magazine belonging to the gun, below, they are not sufficiently strong to resist an explosion of that magazine. There is no doubt about the casemate principle, but it is a matter of detail that in multiplying the number of your magazines you multiply your danger, and render necessary an increase of your complement by as many magazine crews as you have got guns. Mr. Scott Russell laid down four qualifications as necessary to win—speedier, handier, stronger bowed, and more gun power. I would really like to suggest that there is possibly one other point, and that is a—protected pro-

peller. I say that because it is a very serious thing that the fate of a ship having so many valuable lives in it, and costing £500,000 or £600,000, should all hang upon a propeller, and might, as we know, be brought up by very small and insignificant means. My attention was directed to this some five years ago in a small steam yacht of my own, when fishing on the West Coast of Ireland. I found one night, through a bad look-out, while steaming about ten miles an hour, I was suddenly brought up short. We could not make out what it was, but in a very few minutes I ascertained that I was brought up by an old net having got entangled in the propeller, a net so rotten that if you held it in your hand it would fall to pieces. I laid that fact before the Torpedo Committee, and Lord Otho Fitzgerald, in a discussion which took place here on Mr. Thornycroft's paper, alluded to the fact that the smallest rope-yarns or nets would paralyse the action of your propeller. In order to support my suggestion to Mr. Scott Russell, that the protection of the screw is a vital question, I have given a good instance connected with peace, and now here is another that was mentioned in this Institution by Sir William Hall, in the discussion that took place on Mr. Donald Currie's paper. "The 'Victor' on the West Coast of Africa was towing a collier when the screw was fouled by the hawser; they could not clear it, and with the assistance of the 'Bristol' it took 18 days to clear the screw, and they drowned a diver in 'doing it.' So much for peace experience. I will now take one more of war experience. We have heard a great deal about the lessons to be learnt from the German war, and we have heard of the military arrangements which produced the fall of Paris, and we fly away with details, and I think are a little apt, as Sir Spencer Robinson pointed out, to forget general principles. There was a small naval occurrence that happened during that German war, nowhere near the Coast of Europe at all. It was an action fought between a German and French gun-boat off Cuba. The French gun-boat, the 'Bouvet,' was furnished with everything that Mr. Scott Russell lays down. That is, compared with its antagonist the 'Meteor,' it was speedier, handier, and had nine guns to the 'Meteor's' three. How the action was brought about is very instructive, and I have not seen it mentioned in our country except by one magazine. It took place just outside the neutral waters of Cuba, and it occurred in this way. Perhaps Mr. Scott Russell had this case in his mind when he drew our attention to what was likely to happen in regard to naval actions. About 1 p.m. the 'Meteor' observed the 'Bouvet' coming down as hard as she could steam, and fire was opened at 2,200 yards. The 'Bouvet' intended to ram the 'Meteor,' and the 'Meteor' intended to ram the 'Bouvet,' and what happened was this. The 'Bouvet' struck the 'Meteor' a little to the port-side, and for a few minutes the two ships, as described by a German writer, were locked in a short embrace. In that position the 'Bouvet' fired her broadside guns into the 'Meteor,' and I may mention the 'Meteor's' portside was stove in, and that her foreyard was carried away, her mainmast sprung and her mizenmast went by the board. They were in this short embrace for a space of time not long enough to board, and passed each other. The 'Bouvet' tried to turn, but the 'Meteor' managed to bring her guns to bear before she did completely turn, and with one of her guns she planted a shell in the boiler of the 'Bouvet' which immediately put that vessel out of action, and there she was at the mercy of the smaller vessel. Just, however, as the smaller vessel was going to take advantage of her crippled antagonist, her own screw fouled, and she too was utterly powerless and helpless. Now that action lasted over two hours: it was just over neutrality bounds, and the result of the two hours' fight was to place both vessels *hors de combat*. The lesson to be learnt from that I think is this, that had the 'Meteor' possessed a protected screw propeller, she most certainly would have taken the 'Bouvet' or sunk her, though she had three times her gun power, with greater speed and a larger screw, and therefore I venture to suggest to Mr. Scott Russell that the propeller is a question worthy of being most seriously considered. With regard to the general question, Sir Spencer Robinson has rendered it quite unnecessary to repeat all the remarks I was going to make, but I think the question of ships cannot be settled simply and entirely as a question between naval officers and naval constructors. I say so with all deference, and for this reason, that I think that the imperial interests that arise from our geographical position, the strategic arrangements of a gigantic empire like ours,

directly influence the whole question, and that it can only be approached first of all as a principle, as to what you expect of your navy, and what you require your navy to do. Once you have that settled distinctly by the country, and by the House of Commons, I am quite sure your naval constructors can certainly give the empire the ships, and the implements that the naval officers require in order to do, not what the country wants at the minute, but what our imperial position requires that we should do. The fact is, it appears to me, that the country is grossly ignorant of our imperial naval requirements, and catches at any straw to escape from deciding what our navy will have to do in war. I think, when the ordinary British public talks about any one of the magnificent ships, it imagines it should be equal to each and all of these duties; that it should be able to attack any fort; that it should be capable of ramming any iron-clad; that it should be able to skirmish along a water line 15,000 miles long; that it should be equal to keeping station off a neutral coaling port for months; that it should be capable of keeping stations at the crossings of the Equator for months; that it should be capable of defending locally, Singapore, St. George's Sound, &c., &c., and the Colonies of Great Britain, which are sixty times her size; that the same ship must be equally capable of blockading the Amour, or blockading the King of Dahomey, or of keeping station 3,000 miles from its coaling stores. That is the British public's ordinary idea of a ship; and then it must, besides all this, be capable of defying torpedoes in the Danube, or at the mouths of the Nile; I mention this because I do not think that naval officers and constructors are having a fair chance. I do not think that our country, great as it is, at all understands what are our imperial necessities with regard to our navy. The misfortune is this, that though we are a great, and we must always be a great naval power, we think more of the army than of the navy. We shall not have the lessons of experience reaped by others in a great naval war. No great naval war can take place without our being in it. The wars that have recently taken place have been purely military, the whole mind of this country is becoming purely military, and I do think this is a danger, because all our practical experience is gained from military warfare. But when a great war comes this country must sink or swim according to the way in which she is prepared—not as a military nation, but as a great naval power—to meet it.

Rear-Admiral Sir JOHN COMMERELL: You have heard what Captain Colomb has said the nation will require us to do. All I can say is this, whatever the nation may justly require us to do we shall endeavour to do to the best of our ability. With regard to the vessel proposed by Mr. Scott Russell, there is one question I should like to ask him, and that is, if he proposes the guns to pivot entirely in the port, or whether he intends us to have a certain space in the port to enable us, when we are not engaging the enemy at close quarters, to see what we are about; it appears to me that the port that he has described in the casemate will leave us almost in a state of total darkness, and I do not think the men inside would see what they were doing. I believe in action the great point is that every officer and every man in the ship shall know pretty well when he will be called upon for work, and what work he will have to do. As to the gunboats themselves being carriages for the guns, I am afraid that would not answer. In advancing up rivers you would have no doubt to engage an enemy on the banks, and at any attempt to turn to port or starboard, the current would catch the bow, and the chances are, would take you on shore. At the same time I would infinitely sooner see the size of the gun sacrificed to a certain extent if we had a good gun carriage, so that the gun should have a fair angle of training. I cannot understand myself another point mentioned by Mr. Scott Russell, and that is that in his gun-boats he would have a stern fire as well as a bow fire. It appears to me that if both these guns are to be without carriages, simply pointing right ahead and astern, when you are advancing against your enemy, you would always have one half of your armament out of use, and if you were retreating you would have the other half of your armament the same. I should like to get an answer to these questions.

Commander W. DAWSON, R.N.: The meeting will, I think, separate with some disappointment. We came here on purpose to hear naval architects discuss some very important points of naval architecture, and unfortunately we have not been gratified. There were some points that I should have liked to have heard discussed

with reference to the shape of the proposed midship section, whether it is to be a V, a U, or an O? and as to the length of the ship, whether it is essential to go back to extreme length for a good fighting vessel? I am not going into these questions, for I want to direct attention to the offensive powers of ships. The purposes for which ships of war are built, are to damage and destroy by any means hostile vessels and fortresses rather than themselves to merely passively keep out destructive projectiles. Unfortunately the various offensive powers of ships have not received the same attention as their defensive resistances. Mr. Scott Russell, in wishing to avoid the torpedo "scare," has perhaps gone a little too far in overlooking the important auxiliary part the torpedo will play, offensively and defensively, in general actions. If Captain Bridge was present to-day, I would say to him that if the enemy had on either quarter two Harvey towing torpedoes, four or five Whitehead torpedoes on each broadside, one or two spar-torpedoes on each bow, and if the hostile ironclad was so armed in addition to her guns and to her ram, and met another ironclad similarly prepared for action, the ram would probably not be brought into action at all, and the battle would be decided by artillery or torpedoes. Then with regard to the ram, there is a very wholesome respect for the ram in the form now used in the British navy. It has had the honour of sending one of Her Majesty's ships to the bottom, and has nearly sent several others to the same destination! The highly effective character of the ram as at present shaped will account for what Mr. Scott Russell saw at Portsmouth, namely a sheath to protect British ships from destruction by British rams. But there is one point with reference to rams, on which I have a strong opinion that we are going on a wrong tack. If only one third of the ships of the British navy are to be furnished with rams, which third ought it to be? My impression is that it ought to be the smaller vessels. Pit a short gun-boat like the "Ready" against a long ship like the "Northumberland," and let both stop firing and try ramming. Which of the two vessels would be more likely to ram the other? Why the short "Ready" gun-boat ought to sink the long "Northumberland," being much the handiest vessel. If that be so, then, in my judgment, all the small ships of the navy should be armed with rams. I see, with some little regret, a very great friend of the navy, a very celebrated yachtsman, advocating our fitting out gun-less rams. My experience of exceptional vessels is that they are sure to be in the wrong place at the right time. Gunless rams will be sent up the Baltic to attack a fleet, and instead of ships they will have stone walls to attack, what then will be the use of these gunless rams? What again would be the use of gunless rams when attacked by gunboats who shelter themselves from such attacks in shallow water? What would be the use of gunless rams in attacking vessels protected by torpedoes? What superiority would a gunless ram have when contending against a fully gunned ram? I was surprised that so intelligent a friend of the navy, an artillerist too, should have given way to the torpedo scare, so far as to have been frightened out of his guns. All these arms are necessary, and artillery most of all. Mr. Scott Russell has drawn attention to the offensive armaments being exceedingly weak in proportion to the size of our ships. We have ships of some 9,000 tons displacement, carrying only 140 tons of ordnance. Is that floatation necessary? We have a ship of 11,000 tons displacement, carrying only 320 tons of ordnance. Is that floatation necessary? Would not such a ship be more fitted to fight an enemy if she could substitute for some two or three hundred tons of defensive armour that weight of offensive ordnance? Mr. Scott Russell has also drawn attention to the advantage of our going back to the good old custom when every ship in the navy carried guns of very much the same type, capable of penetrating not only vessels of her own size, but the sides of any enemy, however large the hostile vessel might be. We have had, in the last week, an illustration of what I two or three times pointed out in this theatre as a possible occurrence. We have had a British ship—one of the most splendid frigates in existence—and a splendid corvette, sent out to the other end of the world to protect British interests. These two British frigates have fought, not sister ships as they were designed to fight, but a wretched little Peruvian vessel of about one fourth their size, and armed with guns, I venture to say, about one-seventh the weight of those used by the two British ships. What is the consequence? Do the British ships knock the wretched little Peruvian gun-boat into lucifer matches? No, they do nothing of the kind,

and, as I have often pointed out in this theatre, they could not do it, for the simple reason that they have been sent to the other end of the world furnished with guns which cannot perforate the armoured sides of the little Peruvian. British corvettes and frigates are almost inoffensive when called upon to attack armoured gun-boats like the "Huascar." I do not think that British corvettes, sloops, or frigates, ought to be without armour-piercing guns, and without rams, so as to be placed in such a position that any wretched little ironclad shall be able to stand up against their sterns. The guns of wooden ships are not only too small, but we deliberately selected for the British navy that gun which we were officially told gives *decidedly the lowest velocity*, and therefore the weakest blows. Mr. Chairman, I congratulate you, who so kindly came forward on one occasion when occupying a very prominent position to countenance me when I brought the weaknesses of British rifling before the naval public, and I congratulate the Royal United Service Institution, that happily that system of low velocity rifling is now a thing of the past. We shall no longer be able to say of British guns that they give the weakest blows, and fire the weakest shells, and are of small endurance. Whether the system of rifling which has replaced the French stud rifling is the proper system, is another question; but it is a matter of very great congratulation to this Institution, after the discussions we have had in this theatre, that at last the British authorities see the necessity of British guns being able to fire such projectiles as will do the greatest amount of destruction to the enemy, and the least amount of destruction to their own guns, and that will perforate the enemy's ship. Those are the points in the offensive values of ships of war to which I venture to call attention. Our time is short, and had we not been disappointed of our naval architect friends taking part in the discussion, I should not have ventured to have placed these thoughts before you.

Mr. THOMAS MOY, Assoc. I.N.A. *First.* I would epitomise the work of the last eighteen years in the Royal Navy in the words, "Down to the water's edge"—and—"Back again," and I congratulate Mr. Scott Russell for having given the final touch in bringing us back to a wholesome amount of freeboard, and, I think, the sooner those "low flat things" are improved off the face of the water the better.

Secondly. I think that Mr. Scott Russell is quite right in choosing what I would call the *chisel* form of stem for ramming. We engineers always prefer the chisel if we are going to cut into anything, and it is a far better form than the weak under-water ram now used.

Thirdly. I would suggest that this form of ram should be placed at both ends of the ship.

Fourthly. This country possesses a great source of "strength" and of "weakness." Our "strength" consists in the immense amount of inventive talent which we possess. Our weakness consists in the persistent neglect of that inventive talent by every Government which we have.

Mr. SCOTT RUSSELL: I almost feel that my work has been done by the many able men who have given this Institution and myself the great benefit of their opinion on the different points which I raised, far more for the purpose of getting their opinions than of giving out any opinions of my own. Nevertheless I was quite willing to commit myself to some definite statement or other, otherwise I do not think I could have got you to come out as you have done, and give me such precise statements; some, I thank you very much, helping me in the points in which I am strong, and others helping me equally by showing me the points in which I was weak; I am therefore equally grateful both to those of you who strengthen me by strengthening my right opinions, and to those of you who strengthen me by showing the weakness of my wrong opinions.

Now the Chairman was kind enough at the outset to say a word on the subject of the ventilation of the casemates and elevation of the gun. The strength of the casemates was also alluded to by Lord Dunsany. On the point of ventilation of casemates and the lighting of casemates, which was raised later in the debate, allow me to say that that is a serious point to which I have given very serious consideration. If you will allow me, I will not ask you to enter upon any particular plan of mine for ventilating the casemates, but I will simply venture to say this to you, that when we get together for the purpose of doing this, I have no doubt we shall find excellent

ways of doing it. I have already quite matured a method of doing it, and unless we had thoroughly matured a method of doing it, I would not have recommended it to you. But I do not want you to approve of any of my methods. I only want you to say this with confidence, "We will have these casemates properly lighted, and we will have them properly ventilated, and we will have them done in the best way we can discover of doing them; and if Mr. Scott Russell's way happens to be better than other people's, we will take his, and if it is not, we take the other people's." I think that is a much better position for me to take with you than for me to say that "I have a beautiful plan of ventilation—better than anybody else in the world, and if you will only listen to me and my plan of ventilation we shall be all right." I won't say that; but I think I may say to you, that if I had not thoroughly found out how I could with perfect certainty, simplicity, and safety, in the middle of a battle, secure a complete ventilation and lighting of those casemates, I should never have come here and proposed their existence.

Next as to the elevation of the guns, lifting the centre of the gun, and as to all those difficulties, I entirely agree with you that all the difficulties were there, and when I came here I had got over them all, but I said, It will never do in this short lecture to go into every one of them. I said to myself, "I shall find Captain Scott there, and they all know that Captain Scott can make a gun do anything he likes: and we have only to say to Captain Scott, 'Now, Captain Scott, this gun is to be big bore, she is to be breech-loading and muzzle-pivoting, she is to keep out the enemy's shot and shell, she is to be close, and you are to find the way of handling her.'" Now I come to you and say, if Captain Scott cannot do it and gives it up, then I am all ready. That is my mode of working the guns on the pivot system. Captain Scott's first, and when he fails, mine. As to the elevation of the gun, I quite agree with Captain Scott, I quite agree with the Admiral in the chair, that we must provide both for laying the guns and for elevating them. We must do that. But I must come back again and ask you seriously to consider the point I have put, which is not my point, but the point which most experienced officers have put to me. I was talking in all I said to you about laying the guns in a permanent manner during that particular engagement only of *broadsides*; and for the purpose of handling a large ship and a powerful broadside in the dreadfully short engagement which will decide sinking or gaining a victory, I do not think you can leave to individual gunners the doing as they like at their discretion with the guns used for broadside purposes; and therefore I think you ought to make up your mind, before the engagement takes place, what is to be the general lie of all the guns, and what is to be their mode of acting together, and then allow me to say I would call the eight other guns of the ship by—if you like—the old-fashioned name of "chase guns," that is to say, I propose that every ship of any considerable size shall have four bow guns and four rear guns. The rear guns are not for running away; the rear guns are for decoying your enemy to follow you into the place where you want to be followed, and taking him into a scrape he does not understand. That is what I put the four rear guns for, and I think they would be extremely useful in a scrape which I need not tell you about. Four bow guns, parallel to the keel as a normal position, and four rear guns parallel to the keel as a normal position. I think these four of the greatest importance for close and distant action; and remember that this ship of yours that we describe is not only to ram one ship, but is one of, say one dozen, who are ramming at least another dozen of similar ships, and I do not think, unless you are in a position to handle the whole ship with a perfect certainty that each gun is doing what you want, that you can fight that battle and win it; but I may be quite wrong.

Lord Dunsany asked whether the casemates which I described were guarded against oblique fire. That only shows the difficulty there is in a lecture in going through the whole of an enormous subject; but I think you will see first of all, there is in the great central part 24 feet width. (See Diagram II, which shows the fore-armoured bulkhead giving complete protection against oblique fire). Then I am here drawing you the space of the casemate, and there is each casemate with its one gun. Allow me to make an explanation. In one part of the paper I say, "each casemate with two guns in it"; in another I say, "each casemate with one gun." Allow me merely to say that I considered those two points very seriously,

and I beg you to consider them very seriously. I have looked into the question of having one gun in each casemate, and that has many advantages in point of strength ; it has also advantages in point of safety. Then there is another point, I think the companies of two guns will get on better if you have a stronger company at a gun, and two of them, because the supernumeraries can be on the one gun when they are off the other gun. Therefore, in the beginning of my investigation I arrived strongly at the opinion that it was desirable to make each casemate double the breadth, and to have two guns acting together in one casemate. I was only driven out of that by the questions of strength and safety, and coming to the question of greatest strength, with a given weight and the best protection with safety, I came then to the conclusion myself, but I do not at all say it is the right one, that it was better to have the one gun in each casemate than to have the two guns in one casemate. I beg you to seriously consider that, because none but a practical seaman can settle that question ; but I will tell you what settled it in my own mind—the question of security. The Chairman and Lord Dunsany put a very proper question to me, viz., as to the strength of those casemates, and whether what I proposed to have might not lead to a certain source of weakness. I am much obliged for those observations, because they readily lead to a serious point. This ship is a ship we will say of 10 casemates to a side, or 15 casemates, that is to say, you have a ship of 20 or 30 broadside guns. This battery is considerably more, in every case, than half the length of the ship ; but when it comes to this end (see Diagram II), I have there an armour bulkhead going right across the whole end of the ship, and at the other end is a similar bulkhead, so protecting the entire ship in its centre against any effect of oblique or chase fire. It is by enclosing them all within each, first, its own armour, and secondly, the two end bulkheads of armour, that I render these casemates perfectly unassailable to oblique fire. About the question of strength Lord Dunsany said a very wise thing : he said if these ships were made like common ships, full of little bars of iron, which take the place of our old frames, if they were full of these little angle iron bars, that then there would really be no support given to the plate of armour, and that the structure of the ship and the armour plate would not at all aid each other in strength. That is perfectly true, and, therefore, what I propose in this matter is simply this—the “Great Eastern” is one of the strongest of ships, and in her sides the elements of strength are placed at about 9 feet apart from each other, both lengthways and vertically. Now, here I propose that from casemate to casemate there shall be 11 feet, and that vertically it shall be 9 feet, and, therefore, those casemates that I am showing you are exactly the material construction of the “Great Eastern.” *This* wall is nothing but a similar bulkhead ; *this* wall is nothing but the two great longitudinal bulkheads that constitute the strength of the “Great Eastern,” and, therefore, the casemate is made of nothing but the iron deck below, the iron deck above, both of which are necessary parts of the ship ; those cross bulkheads which are necessary parts of the ship, and go from the longitudinal bulkhead to the outside ; and, therefore, six sides of the casemates are only the six large integral elements of which the ship is built. Then, in order to give these due strength, we plant on each side of these a single large plate of armour, which covers the whole, and which end where these powerful buttresses begin, and, therefore, the whole force expended on this plate is propagated through these to the whole body of the ship, and each plate has as its reinforcement the whole body of the ship ; therefore there is no doubt whatever that by that method you can convey to the plate the whole strength of the internal body of the ship. I did not show, because it would complicate it, that the knees of the ship would come in at each of those corners (Diagram II), and every one of those plates would here be fitted by a great knee, and that corner would be upheld by another great knee, and then above and below and up and down there would be all these knees coming in to support the whole of this armour plate, so that that armour plate is really in the strongest position in which it can be placed.

Captain Price said, with regard to the form of the bow, that he liked the spear. Well, I should think a soldier would like the spear, and equally the gentleman who was an engineer said he preferred the chisel to the spear. With respect to ramming the ship, Captain Price also mentioned what had occurred to myself as a most serious consideration, that poking a hole below the water gave a greater power of

inundating the ship with water, than of course poking a hole above the water or near the surface. That is quite right, and I had already seriously taken that into consideration, or I should not have proposed it to you, and therefore I merely call your attention to that drawing, and to request you to notice that if a spear cut into the bottom of that (Diagram I) below the armour plate, which was his intention, it would find itself in a watertight compartment, which either would be already filled with fuel, or if the fuel was taken out would be replaced by water ballast, and that the poking a hole into that ship at that place with his spear would do her no harm whatever. And the only reason I ask you to believe that is, that when the "Great Eastern" was speared in like manner by a rock big enough to tear in her a hole nine feet wide and eighty-three feet long, it went into the compartment, and she continued her journey to America as if nothing had happened, and came back from America as if nothing had happened. I advise my enemies to take a spear prow, but I advise you as my friends to take that chisel, which chisel will open up the side of the ship, and across several decks, and so not only admit water on several decks instead of one, but will cut up so much of the strength of the ship by severing all these decks that you will do infinite constructive harm to the ship at the same moment that you inundate three decks with water instead of one.¹ Those are my impressions. In regard to torpedo boats, I perfectly admit the good policy of England building torpedo boats, and perfectly admit the good policy of England furnishing her fleets with better torpedo boats than anybody else has. I entirely agree that the fleet shall be surrounded with every kind of vessel. I may also say I do not undervalue a vessel with a turret in it for going up a narrow winding inland channel, so that the ship may be keeping her own course, while her gun is always lying on the enemy on land; and I do not say a word about pivoting guns or against guns in turrets, because there are special services for which I entreat you to build turret ships, because they are better than any other, and there are other uses for which I entreat you to use guns with the greatest possible sweeping power and the greatest command over every direction; only I say, use them in the discriminating places for which they are wanted, and do not for a theoretical, or exceptional, or fanciful mode of application, sacrifice the great element of a broadside gun, namely, destroying your enemy, when you come to close, fierce, deadly contact with him. In regard to very small gun-boats, I think there is a great difference between what I would call a squadron of gun-boats, because it would be my intention, if we made those one-gun boats I have stated, to use a number of them together. I think I should send out, if an enemy were getting troublesome, not one of those gun-boats to meet him, nor two of them, nor three of them,—I think I should send out twenty altogether, and sending out twenty gun-boats altogether to act on the same enemy, especially if he was a big fellow, I do not think that any more manœuvring power is necessary than that of a clever captain in

¹ The author of the paper has since received the following letter from a distinguished naval officer:—"Dear Sir,—I was pleased, when reading a leading article on your recent lecture at the U. S. Institution, to find that you advocate straight stems for war ships. Ten years since, in an article on ship-building, which I published in the *Mechanics' Magazine*, I stated that for strength, security, and means of offence under any circumstances, they would prove superior to all others. In another article on the Navy, which appeared in a leading magazine a few months since, and which excited favourable comments from the *Times* and other sources, I again alluded to the subject. It is possible that I may again write on the Navy, as I am not satisfied with the present types of war-ships. By a singular coincidence, in another paper, which was also published in a leading periodical, I took your view of torpedoes. Certainly, recent improvements appear to have made them more manageable; but I still look on them as liable to be dangerous weapons of offence, unless it be from negligence when at anchor.—For defence, with the aid of electricity, their power will be great, and should this country unfortunately be forced into war with Russia, the tactics will have to be greatly changed from what they were in 1854-5. We then had no fear of such enemies, although several were fished up off Cronstadt and other places. Trusting you will excuse my addressing you,—I am, &c., &c.

a handy boat; therefore I request you to draw a distinction where you think it necessary; make your little boat with a large bore gun, one that is to go in a numerous fleet and attack a big enemy, and put big enough shells in the guns to sink that big enemy, and do that for your general purpose; but if you want very delicate manœuvring guns in gun-boats for special purposes, by all means build them for those special purposes, and give them special names which shall indicate that they are meant for that special purpose and not for another. The one thing I confess I should like to feel in a little steamer, if I was going into an enemy's country, would be to feel that I had only first to get near him and then to take my own quiet time of pointing my gun at him, and to feel that if that shell got into him he went down and all was right. Major Baylis said torpedoes certainly were a great danger. Now I entirely agree with that. I am very sorry any one should think I did not imagine they were a great danger—I know that they are very serious dangers and ought to be looked after. But really, after all, I can say nothing to you about torpedoes but this—Let a fleet be composed of all the proper arms that ought to compose a fleet in correspondence with what Admiral Robinson so wisely said, and then let it be distinctly understood as between you and me that the great way of meeting torpedoes is this, to sink the torpedo boat first, and that there is no other way of getting rid of it. I think that is the maxim we ought to keep in view—whether you think a torpedo boat is the best thing to sink another torpedo boat, or whether you think that a very handy quick gun-boat, with a great big gun firing into the torpedo boat, is the best way to sink her, is a matter which I must leave entirely to your choice who have got to go and do the deed and have therefore the right to choose your weapons, but I would choose the guns.

Mr. Welsh gave us a very interesting account of these Chinese gun-boats and the Argentine boats, but I merely call his attention to this, that for an English Navy I should like longer boats, I should like faster boats, and I should like boats drawing more water, able to keep the sea, and coaled for a tolerably long voyage. All these little shallow-water short boats are capital things, but I entreat you to consider that though they are capital things for rivers, for harbours, for local protection, for drilling men in gunnery, still you must draw a marked distinction between local special services of that kind and such a fleet of gun-boats as must be made to accompany our fleet of large ships and assist them in their operations. Now these are totally different classes, and I think a fleet, in order to be fit for all its uses, must be composed of both, and therefore, as I said before, the small vessels which are to protect the empire abroad will have to be sent out there and be ready for the work there a good while before the big vessels are called upon. But I think it would be a grand thing to feel that there was a great fleet of our gunboats out, we will say at Sydney or some such place, and that there were a couple of great fleets out somewhere in the Pacific, and that some fine morning, when we heard that somebody or other had sent ships somewhere or other to do something we did not like, that we then had nothing to do at home but say first to the ships of the largest class of the line, "Ten of you please get ready and go to-morrow to that place"; and that they should be accompanied by two classes smaller than themselves, but able to steam the same distance; and if that fleet were to leave on the instant, without anybody knowing where she was going, and go out there and find an assemblage of gunboats and good sailors in our colonies and other parts of the empire all ready, and wanting nothing to squash the enemy, except our presence with these large ships; I think people would feel that that was an empire of which they had reason to be proud, and in the government of which, they might place infinite confidence.

Admiral Robinson has been kind enough to go into this matter very seriously. He admits that what is wanted in a fleet is that there shall be some standard ship, and some standard unit of a gun-boat, and some standard gun to that; each standard composing an integral part of fleet shall never be called a fleet until it is surrounded by all the several ships which belong to a fleet. What these ships are you can easily sum up, but they are first of all our great ships of war; frigates not so heavily armed, which will accompany them, and which will be able to deal with all the enemies of a weaker sort than those with which these have to deal; then you have transports and despatch vessels and cruisers, and you have all those classes which are necessary to form a fleet. Now there are so many clever mechanics and ship

builders in England who have no work to do, and there is so much iron in England just now that nobody knows what to do with, that this seems to me a happy moment for you professional men suggesting to the country that as we are at perfect peace at present, now is an admirable opportunity to make ourselves perfectly ready for war against anybody in any part of the British empire. Admiral Robinson, I think, has done us great good by his kindness and his courage, for I am told it wants a great deal more courage for a naval officer to speak out on land than it does to sink his enemy at sea. I do not know whether I am right. We want then, according to Admiral Robinson, a fleet, not a ship, and we never should expect to build a ship which will go everywhere and do everything. We build a fleet of ships for general larger purposes, and we build flotillas of special ships for special uses; that is plain practical wisdom.

Captain Scott has been kind enough to grasp the whole question, and he also says that he took into consideration how to build, not ships, so much as a fleet, in order to protect our commerce all over the world. He has also backed my maxim that the way to get rid of torpedoes and other enemies is to sink them first; and he knows, as I do, that the rocket is a weapon; that the shell, in several shapes not generally known, is a serious weapon; that these are not to be neglected; but though they are not to be neglected, we are not to make them a scare to ourselves or to our friends. I agree with Captain Scott, that if you can get simple mechanical appliances that won't go wrong, to help you to work your guns, to help you to steer and manoeuvre your ship, you will be most unwise to neglect such help, but I think you would be most unwise to trust for the fighting of your great ships solely to the perfect working conditions of the terribly complicated apparatus of which you and I have heard a great deal too much. And let me simply say to you that the first stroke of your bow on the enemy, or of his on you, will give a little twist to this bulkhead, and a little twist to that bulkhead, and will poke up a little bit of iron of the ship this way, and buckle down another bit of iron in the ship that way, and I will tell you that nine-tenths of the horrible complications of machinery which I have seen proposed, not to say executed, for your war ships will be utterly useless on the first slight contact with your enemy. Though I am an engineer, though I believe in machinery, I advise you not to believe in clever tricks of mechanism that I or anybody else teach you,—and be sure of this, first, make your rudder and your steering gear and everything belonging to it so that your crew can steer without any engine or machinery; secondly, have your guns so arranged that they can be worked without a steam-engine being in good order, or the hydrant press being in perfect condition, or without all the lines of the mechanism being mathematically true,—take care that you can work with your own crew your own guns. And if you ask me the reason why more strongly than any other I lay such weight on having a breech-loading gun instead of a great muzzle-loading gun worked by steam-engines, I tell you why, because I have seen big breech-loading guns handled by two or three little fellows working at the breech of the gun in such an exquisite and rapid manner as no machinery of hydraulics or steam in the world could accomplish. But in order to do that it must be breech-loading, and a handy little breech-loading gun fifteen inches in diameter will be worked by half-a-dozen Jack tars, and say in half the time that any of your great guns can be worked. Therefore I entreat you to keep to the simplicity of all the mechanism on board a ship, to keep in reserve, to be handy, some very simple mechanism which, when you are very tired of fixing so many guns at your enemy, will come in and give you a little relief. In the ships I have shown I have divided the weight pretty nearly thus:—I have divided as nearly as possible the 4,000 tons' weight of armament, taking 2,000 tons' weight of guns and ammunition and 2,000 tons' weight of armour, and I compelled myself to make the best I could of that; and I have done so by the arrangement I have now shown you. By going a little further I could have 3,000 tons of armour and a corresponding increase in the guns. I think that is of great importance, because you see there will be a far more powerful armament in that ship I have shown you, in regard to her weight of armour and the weight of the ship altogether, than anything you have yet been familiar with. Therefore with regard to guns, I think, that for this close fighting,

which must be the accompaniment of ramming, a big bore light gun and a large shell with a high initial velocity, is something you ought on no account to deviate from. I have no knowledge of firing by electricity, but if you ask me how I meant to fire from these casemates, I will answer you. I intended that at each casemate there should be a small hatchway opening up on the upper deck. In each of these you have loaded your gun, and in each there is a gunner standing below ready on the slightest hint to fire his gun. He is standing there at his work, and the commander is standing along this line and sees all the captains of the guns who are looking out at him for the signal. I fancy he is standing here, and they are all ready, on the instant of his giving the signal, to fire each his own gun. If you do not approve of that, you no doubt will prove a better way of doing it. There is a way which is very well known, namely, firing by electricity. I do not know, only, I say again, use electricity for what it is fit for, but do not trust to it, and do everything with your own men as much as you possibly can.

With regard to the shot being broken by double layers of plate, I quite agree there are very serious points of that kind coming up now. I have the whole side of the ship along that battery three feet thick for strength (see Diagrams I and II), independent altogether of armour, and therefore that three feet thick encloses every one of those large armour plates as it were in a case, and whether you divide that into two or three—whether you fill up the interval by wood or not, do it which way you like, but there is no doubt whatever that you can in this manner combine the strength of the armour plate with the strength of the materials of the ship. But there was one very excellent criticism given, which was this: it was said, "If the plate of your ship is as you say outside the sheet of armour, then, when the shell comes, the first thing it will do will be to damage that part of the skin of the ship." That is just what I wanted it to do. I wanted it to go through and damage that part of the ship, and hammer that iron, which it does, into a little buckle; but having done that, it has done no harm whatever to the ship or the strength of the ship; it has altered none of the fastenings, because no support is derived to the plate from that part of the plate: all the support to the particular armour plate is derived from those buttresses along with those knees which I spoke of, and I said to you that every one of those outer plates of the skin could be battered by half-a-dozen shells, and the cells inside would all remain perfectly water-tight, and no harm would have happened, and it would still form an enclosure which would grasp the iron plates all round, and so prevent the portions of it, even if it had been split, from tumbling and falling away, and would keep every one of them in their places, so that as long as there was material to be broken, the material would be there and would require force to break it.

I think it most important that the propeller should protect itself. I cannot go into that method now, but I wish you would have a paper read here by other people on that subject, and if you would just say that what you want is a propeller capable of protecting itself, I think I could show you how a propeller may be made not only to protect itself, but to make its enemy very uncomfortable. The propeller I do not think is to be made to protect itself by putting any nets around it. I disapprove of all such complications; but I will only tell you I have seen a kind of propeller, and used it for practical purposes, which no ordinary and even no extraordinary process which I can understand would render useless, and I think that is well worthy the consideration of this meeting, and I shall be ready on such an occasion to give you such a propeller if no one else does.

Then another point with regard to propellers, I think most serious, it is this, that your screw propeller is a bad propeller sternwards. Why not say, "A ship of war must be able to go as fast astern as ahead?" Why not say so? And then when you have said so, why not call upon people who have made such things their studies to put it into execution? I assure you, handling a ship as I have had to do, which goes forward and backward equally well, is one of the greatest pleasures in life, and you can make such a ship do anything you like. Such vessels have been made, only at present we are in a very serious difficulty, we are in a sort of curious entanglement about screws. I do not know if you have seen our double screw war vessels. I dare say you have seen them with great big beams sticking out through the water in the most unmechanical manner to grasp the screw. I am sure an old ship-builder never

would construct a vessel with big beams going through the water in order to grapple a distant propeller and keep it in its place. It would, I am certain, be easily entangled by cables, or injured easily in collision by clever enemies, and I entreat you to get rid of such an arrangement, for it is an abomination and a danger. I will only, in conclusion, repeat the old maxim that "ships good for everything are good for nothing," and apologise for taking up so much of your time.

The CHAIRMAN: I am sure, after this lengthened lecture and debate, there can be very little doubt of Mr. Scott Russell's cleverness, and his ability to instruct us. We are very much indebted to him, not only for the amusement he has afforded us, but for the good solid instruction we have gained, and I am sure the meeting will join with me in thanking him very much.

Evening Meeting.

Monday, June 11th, 1877.

DONALD CURRIE, Esq., C.M.G., in the Chair.

ON THE EMPLOYMENT OF CLARK AND STANDFIELD'S FLOATING DOCKS AT NAVAL STATIONS, AND THE MEANS THEY AFFORD OF TRANSPORTING LARGE IRONCLADS THROUGH THE SUEZ CANAL.

B. LATIMER CLARK, Esq., C.E.

A PAPER, which has attracted much attention, was read in March last before this Institution by the Chairman this evening, Mr. Donald Currie, "On Maritime Warfare and the importance to the British "Empire of a complete system of Telegraphs, Coaling Stations, and "Graving Docks."

In the course of that lecture, and of the interesting discussion which followed it, great stress was laid upon the importance to this country of laying telegraph cables between England and certain of our colonies and naval stations, and especially of connecting this country with the Gold Coast, the islands of St. Helena and Ascension, and with the Cape of Good Hope and Natal, chiefly on account of their value during time of war; also of establishing coaling stations at certain places indicated, and of providing them with adequate fortifications. The essential importance to our Navy of being able to obtain full and abundant supplies of coal in these distant seas, and of our protecting these coaling stations from capture by enemies, was forcibly dwelt upon. And lastly, Mr. Donald Currie alluded to the serious injury we should probably sustain in the event of war, in consequence of our having on the Australian route no graving docks or naval stations where vessels can be repaired or refitted. The complex nature of the machinery employed in a modern war vessel propelled by steam was pointed out, together with the fact that there is no port nor graving dock between England and Bombay, nor between England and Australia, where a heavy ironclad can be docked or repaired. In the event of accident or injury to any of our large war vessels, they would have to proceed

D'S
THE
RGE

last
hald
tish
and

which
try
nies
the
the
value
tain
ons.
and
ing
welt
ury
our
ons
the
was
ock
ilia,
acci-
eed

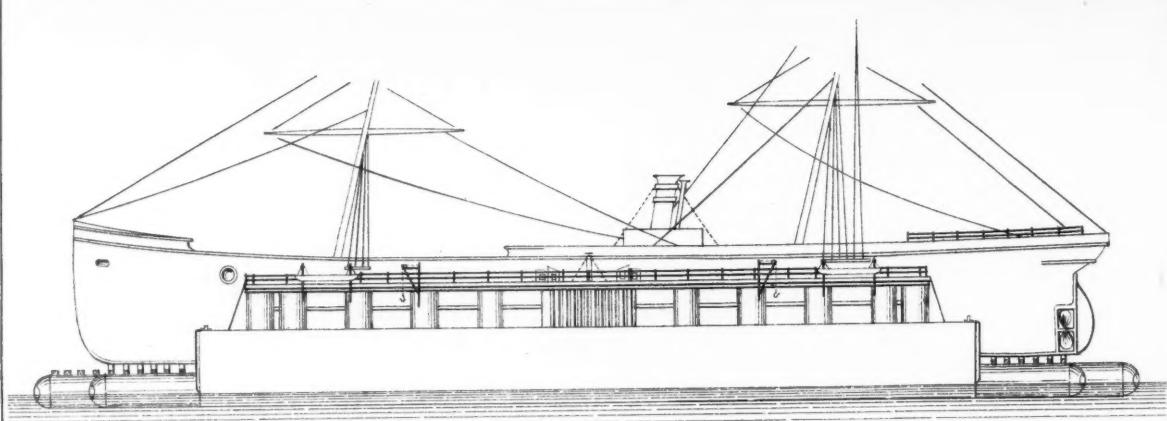


Fig. 1.

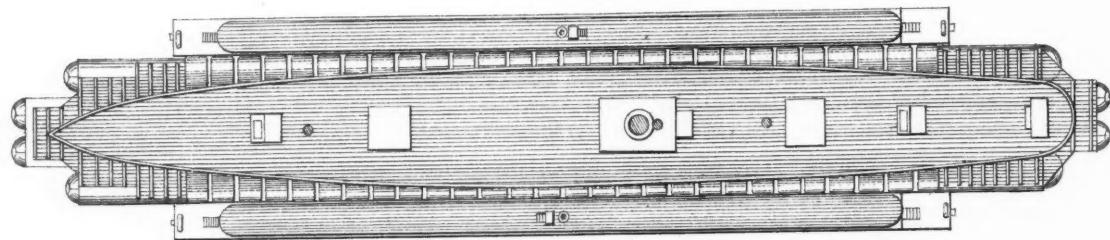


Fig. 2.

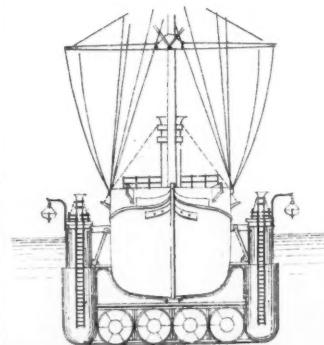


Fig. 3.

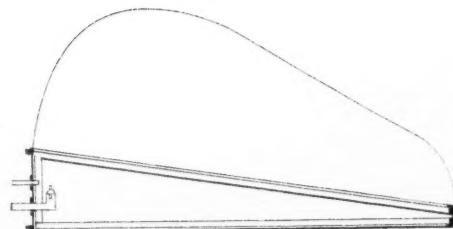


Fig. 4.

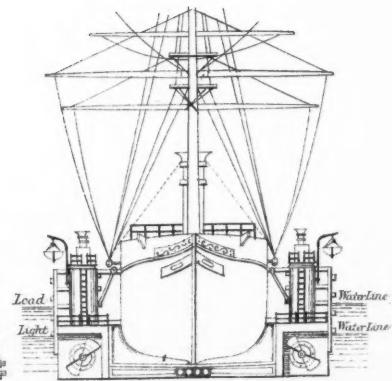
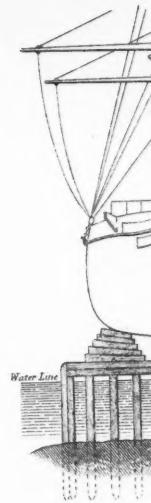


Fig. 5.



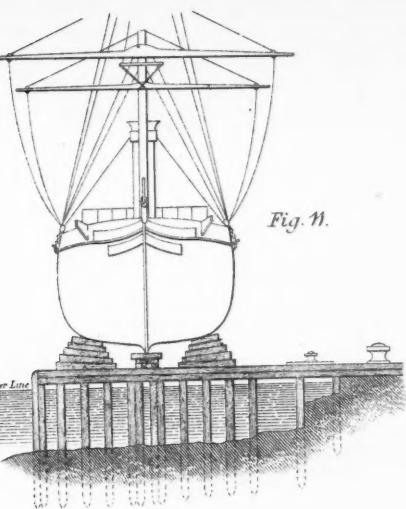


Fig. 11.

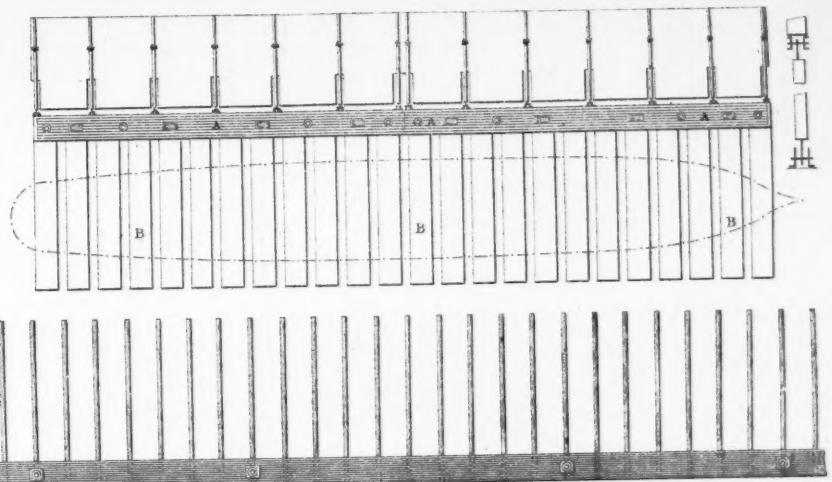


Fig. 8.

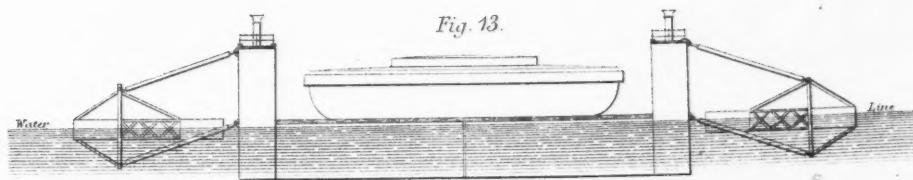


Fig. 13.

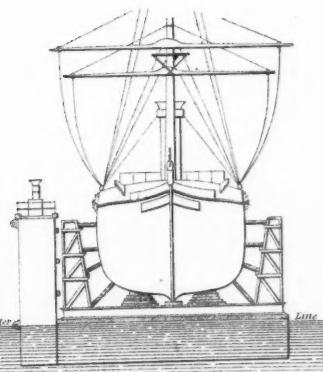


Fig. 12.

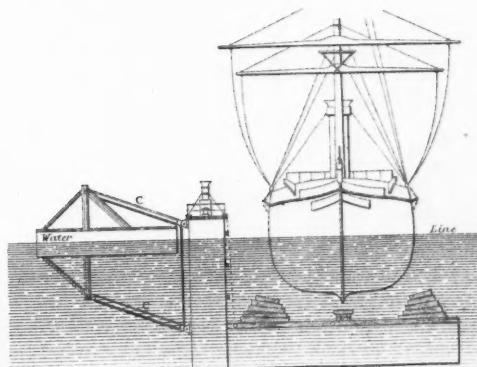


Fig. 9.

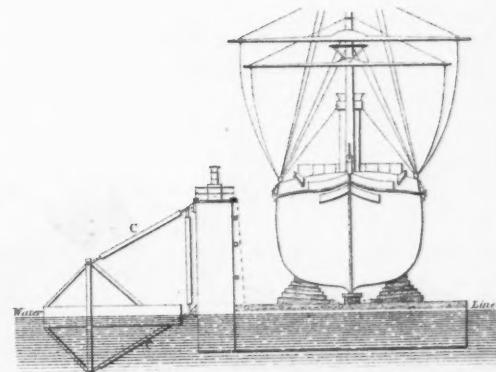


Fig. 10.



either to England or Bombay, as is even now necessary whenever they require to be cleaned or painted. Mr. Currie proposes therefore that the Home and Colonial Governments should combine in establishing adequately protected coaling stations, connected by telegraphs, at certain selected points, and supplied with all requisites for repairing and cleaning war vessels; this recommendation is one which must commend itself to every one who has carefully considered the subject.

I do not propose to touch upon the subject of their connection by telegraph, except to point out, as I have done on former occasions, how desirable it is that the exact position of deep-sea cables should be in all cases kept secret. At present it is an ordinary thing to see in the newspapers reports of the progress of cable-laying expeditions, giving day by day their precise latitude and longitude. It is the custom of those who are interested in submarine telegraphy to keep careful records of all such notices, and it is evident that hostile Governments are thus provided with sufficient information to enable them easily to destroy our telegraph lines by night or day, even in deep water, by means of small vessels suitably equipped; if the exact positions were not published it would not be at all easy to find the cables in mid-ocean, and near the coasts they might be protected by cruisers.

In the course of the discussion which ensued, Admiral Selwyn, R.N., drew attention to a particular form of floating graving dock designed by my partner, Mr. John Standfield, and myself, which he considered likely to supersede the costly, immovable and inextensible stone graving docks hitherto in use; and I have thought that some description of those docks and of the peculiarities which they possess, together with some observations on the manner in which they could be most advantageously employed might be of interest to the members of this Institution.

The docks in question are made in two distinct forms, having certain features in common, but each designed to meet special requirements.

These forms are:—

1st. The Tubular Floating Dock, which is the well known ordinary floating dock in a modified and highly improved form.

2nd. The Gridiron Depositing Dock, which has the peculiarity that by means of one dock any number of vessels can be lifted out of the water and deposited high and dry upon timber stages.

The most important advantages these docks possess over fixed graving docks, are their greatly reduced cost for accommodating a large number of vessels; the short time in which they can be constructed; their independence of all foundations and adaptability to any site; the rapidity and economy with which they are worked; the facility with which they can be towed from port to port, or taken up a river or creek out of reach of hostile cruisers; their power of raising vessels of unusual beam, such for instance as circular ironclads of any diameter; and as regards the depositing dock, the facility for docking any number of vessels simultaneously with a single dock.

The tubular floating dock is an improved form of the old floating dock, with the advantages that it is capable of being towed in rough

water, and is adapted for docking ships laden with their full cargo, or heavy armour-clad vessels. The bottom of the dock consists of a series of parallel tubes or boilers running the whole length of the dock, and usually about six or eight in number, the centre ones being somewhat the longest, as shown in Figs. 1 and 2. They are stiffened internally by rings of angle iron about every two feet or two feet six, and also by a number of bulkheads, which divide the tubes into a series of water-tight compartments; they are connected together laterally by an iron framework stiffened with keelsons above and below so as to form a series of transverse girders at distances of about ten feet. This tubular form of construction not only possesses great strength and stiffness, but it is the form which is above all others best adapted to withstand the external pressure which has to be supported when the dock is fully submerged, a pressure often amounting to fifteen or twenty pounds on the square inch; it is also equally adapted for containing compressed air, which as will be presently described, is largely employed in one part of the operation. In the ordinary square construction of docks, the necessary strength can only be obtained by the employment of a large number of internal struts and stays, which add considerably to the weight and expense of the structure. The rectangular form is in fact as ill adapted for docks as it is for steam boilers, and should only be employed when necessity compels it. The tubular form, which is well understood by workmen, can be constructed very cheaply and rapidly. The two outer tubes support the sides of the dock. They may be cylindrical like the other tubes, but there are reasons for giving them preferentially the U shape shown in Fig. 3; the bottom of these has the section of a half cylinder, and the top that of a square box girder running the whole length of the dock, on the top of which the vertical cylinders forming the sides of the dock are planted; the advantage of this form will be more apparent when we come to deal with the question of stability; the top forms a convenient platform for workmen.

The sides of the dock are composed of a series of vertical cylinders placed at short distances apart, and connected at the top by a broad and rigid continuous platform, as shown in Figs. 1 and 2. The distance between the cylinders is sufficient to form convenient landing platforms for boats conveying materials to the dock, as shown at Fig. 2. Some of these cylinders are hermetically sealed, so that the dock can never under any circumstances sink, others are provided with valves for the ingress and egress of water and air, and those near the centre contain the engines and pumping machinery as indicated at Figs. 1 and 2. The connection between the bottom and sides is further strengthened by diagonal frames or gussets at regular distances, connected by longitudinal timbers. These diagonal shoring frames may be fully developed as shown at Fig. 12, or may be reduced to mere gussets according to the class of vessel for which the dock is designed.

The longitudinal stiffness of the dock is very great, and is due, not only to the rigidity of the tubes themselves, but to the strength of the deep girder formed by the connection of the upper platform with the

sides and the bottom tubes. The lateral stiffness is secured by the transverse girders before mentioned. In considering this point it is important not to lose sight of the fact that the upward buoyancy of the tubes acts directly under the vessel to be supported, and that no considerable part of this buoyancy comes from the sides of the dock, their only function being to keep the dock afloat when submerged to its full depth, at other times they are out of use, and the buoyancy of the two outer tubes is chiefly absorbed in supporting the weight of the sides and machinery.

The dock in its simplest form is raised in the usual manner by pumping out the water, and lowered by admitting it, and the vessel when docked rests on keel blocks, and is further supported by sliding bilge blocks, which are hauled in under the vessel by chains in the usual manner as soon as a firm bearing has been taken on the keel blocks.

The various separate compartments of the dock, which are commonly about 64 in number, are all connected with the pumping machinery by separate pipes, which are united into four principal groups, corresponding to the four corners of the dock, so that the level can be easily maintained at all times. A similar arrangement permits the regulation of the ingress of the water when the dock is being lowered; but under no circumstances can the dock sink entirely, either by accident or intention, on account of the buoyancy of the closed water-tight compartments.

With so great a width of beam the immense stability of the dock must be obvious; it of course far exceeds that of any vessel which can enter it; but in docking ships in a floating dock there is one point where the stability of the whole mass is less than in any other position. This is at the moment when the vessel is raised so high that all but her keel is out of the water, while the broad platform of the dock is still submerged. At this point the stability is derived entirely from the sides of the dock, the vessel itself having none. A little later, when the main platform of the dock emerges out of the water, the stability becomes proportionally augmented. The peculiar half circular and half square section of the two outer longitudinal cylinders before alluded to, and shown in Fig. 3, is designed partly with a view to give increased stability at this critical point, which it obviously does in the fullest degree.

The form of the dock renders it well suited for withstanding the effects of a rough sea; the vertical tubes internally stiffened and tied together at top form a combination of great strength; the circular form affords no large surfaces against which the water can strike, and the interstices between the tubes allow the seas to break up and pass harmlessly through them. In an exposed roadstead the dock might with advantage during storms be allowed to sink and rest on the bottom, exposing only the top of the cylinders.

The dock as I have thus far described it is adapted for the ordinary uses and purposes of a floating dock, and for these only; but for colonial harbours, and especially during time of warfare, it may be called upon to perform another duty, for which ordinary docks are not so

well adapted. It may have to receive a disabled vessel either with a cargo of merchandise, or with her store of coal and munitions of war. The docking of a vessel under such circumstances is a problem which few captains care to undertake in any form of dock, and would only do so under urgent necessity.

These docks are, however, provided with an appliance not hitherto described, which specially adapts them for such purposes. As I have before stated, the dock is supplied with the usual keel blocks, and sliding bilge blocks. Now in the spaces between these the whole bottom of the dock is provided with a number of air cushions, which, when inflated by air, rise up under the bilges of the vessel, and support her over her whole surface as completely as if she were lying in a water bed. These cushions are composed of many thicknesses of stout canvas embedded in india-rubber, forming a very strong but flexible texture, capable of readily supporting a pressure of 30 or 40 lbs. on the square inch, or much more if required. The bottom of the cushions is of iron, resting on the floor of the dock; the sides, up to a certain level, are also of iron, as shown in Fig. 4; the upper portion alone is flexible, and when fully inflated it assumes a wedge-shaped form, the thin part going under the ship's bilges, and the thicker portion supporting the sides, as shown in Fig. 3.

When the vessel is fully supported and shored on her blocking these bags are not in use, but lie flat down in their iron recesses, shown in Fig. 4, and are protected from injury by being completely planked over, the planking forming a platform for the workmen during repairs. If the vessel contain a full cargo or an unusual weight of coal or machinery, the cushions are kept constantly inflated and are used in addition to the ordinary blocking, a greater pressure being maintained on those bags which are under the heaviest weight; if the vessel be light and require to remain some time on the dock, the cushions are only used in the act of docking, and as soon as the bilge blocks are in place, they are allowed to collapse and fall back into their recesses.

In the operation of docking a vessel she is first hauled into position within the dock; then by opening certain valves, the compressed air is admitted gradually to a certain number of the cushions, which, by the buoyancy thereby conferred on them, cause the dock to rise up until the keel blocks rest against the keel. Air is further admitted to the cushions, and the water is pumped or forced out of the compartments of the dock till the vessel is raised to her full height, resting partly on her keel, but supported on each side over the whole surface by the air cushions; it is evident that the support thus afforded is the same as that given by the water, and is sufficient to enable a vessel to be safely lifted even with a full cargo of loose grain, or laden with guns and ammunition. This is shown by the consideration that if a vessel draw say 30 feet of water, the upward pressure of the water beneath her bottom can never exceed 15 pounds on the square inch. If the air bags extend over the whole area this pressure within them would support the vessel's entire weight; allowing, however, for unoccupied space and for the weight resting on the keel blocks, a pressure of 20 pounds on

the square inch within the bags, would be as much as would be required for the heaviest vessels, and this may be reduced to any desired extent by hauling in the bilge blocks at any stage before the full weight of the ship is lifted; or the two systems may be used in combination; independently of the comfortable support given to the sides of the vessel, and the power it confers of lifting laden vessels without strain, we have the further advantage that, with this form of lift, we are quite independent of the form of the vessel's bottom. When docked, any one or more of the cushions can be of course removed at pleasure for the purposes of examination or repair.

The compressed air is supplied by ordinary air compressing machinery, and is stored up in large quantities in the chambers of the dock, their tubular form rendering them peculiarly fitted for this use. The engines may be pumping quietly for some hours before the docking commences, so that when the lift is taken not a moment is lost. The whole of the water may, if required, be ejected from the dock by compressed air instead of being pumped out, and with some advantage, on account of the great lightness of the air-pumping machinery, the high speed at which it can be driven, and the small size of the connecting air pipes.

An obvious extension of the principle above described converts this dock into a shallow water ship-float, that is to say, a dock intended for raising vessels and conveying them over shallow bars into rivers or harbours. The changes necessary to effect this are sufficiently apparent: the bottom or floor of the dock is made as shallow as possible so as to give a light draught of water, as shown in Fig. 5. The whole interior of the dock is provided with cushions, not only to sustain safely and without risk or damage a fully-laden vessel, but also to receive the shocks which must occur in the act of docking. The sides of the ship-float are also protected with cushion buffers for the same purpose; finally, she is provided with steering gear and twin screws, as shown in Figs. 5, 6, and 7, or some other form of propulsion, to enable her to steam about at a moderate pace without assistance. Her engines are of extra power, and serve both for raising the vessel and for propulsion. She forms a perfect dock and a perfect ship-float.

The importance of being able to convey a vessel or a number of vessels over a shallow bar or up a creek or river is obvious, both as regards the purposes of commerce and of war; and it is worth considering how far the use of the system can be practically extended to exposed harbours. Within the harbour and in quiet waters, the operation of receiving or undocking a vessel is of the simplest character, and presents neither risk nor difficulty; there are also many positions where sufficient natural shelter is found on the outside of a bar for such operations, but more usually the outside is exposed, and docking could only be safely performed during certain favourable winds or in calm weather. The only time of danger is at that particular moment when the ship and dock first come into contact. It is certain that in rough water a rigid dock of the ordinary character on first touching a rigid vessel would cause serious injury either to one or to both; the case would be very different with a mass of air cushions. Mooring the

Fig. 6.

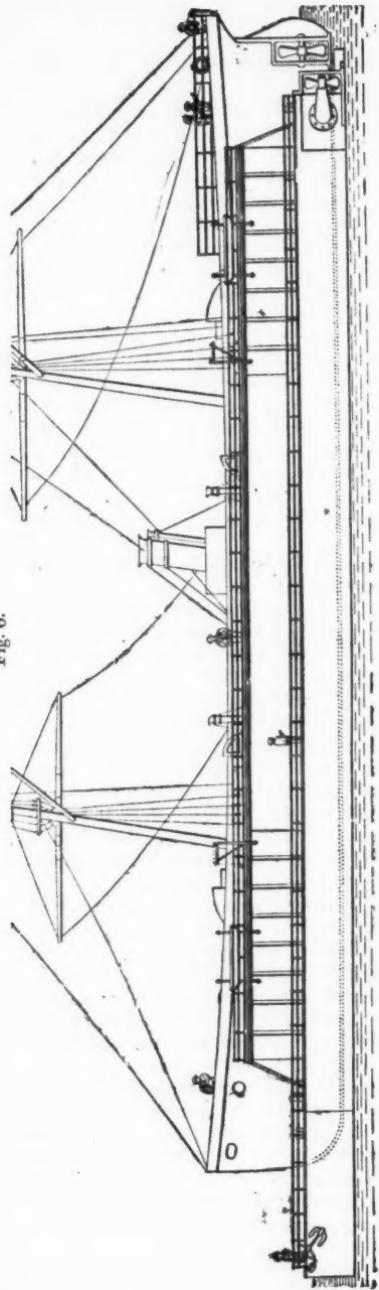
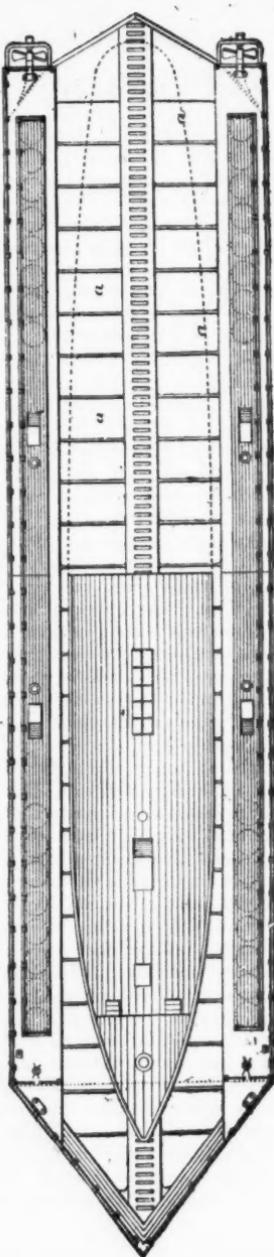


Fig. 7.



dock end-on to the seas, with her bows closed by bulwarks as shown at Figs. 6¹ and 7, she would of herself give considerable shelter. On hauling the vessel within her, the first shock would be either against the sides or the bottom, and in either case against a mass of soft cushions. If against the sides, the blow must be slight, as there are no forces tending to move either the ship or the dock laterally. If care be taken to allow ample margin of flotation, the upward shocks must be equally slight for the following reasons:—The rise and fall of the dock and its pitching movements must be necessarily accompanied by the rise and fall of the water within it, and consequently of the vessel itself, which would thus begin to partake of the movements of the dock as soon as she entered it, and would do so almost completely when wholly within it; if skilfully managed, the ship ought not up to this point to have touched either bottom or sides. A few of the cushions, especially at the end, are now fully inflated by opening communication with the reservoirs; the effect of this is two-fold: it first causes the dock to rise somewhat out of the water, and secondly it gradually closes up the space by which alone water can enter or leave the dock. As this proceeds, water flows out of the dock, and its place is gradually supplied by air cushions; so that by the time actual contact arrives, the vessel is floating among an almost solid mass of air cushions, and its movements will have become identical with those of the dock itself. As soon as a few of the cushions begin to bear against the vessel, all danger is past, and the float and ship both roll together, and have practically become one structure. When the vessel is once docked, it matters not how rough the water may be, so that advantage may be taken of natural shelter at any convenient distance from the bar, or a small artificial breakwater may be constructed both for the protection of the dock and for enabling it to raise or deposit vessels.

There is one place for which such a ship-float is specially adapted, and where it might perform important services to navigation—that is, at the Suez Canal. With a very slight assistance from such a float our heaviest ironclads may pass to and fro through the canal with facility, as well as the largest and most deeply-laden steamers.

This hitherto impossible feat would very greatly add to the efficiency of our large war vessels in time of war, and appears to be worthy of the serious attention of the Government, especially of the Admiralty.

Should the problem of a sea canal through the Isthmus of Panama be soon attempted, the services of these useful docks would be equally valuable. The mere time which would be gained by bringing such a canal into use with shallow excavations, instead of waiting till their full depth could be completed, would alone be of great importance; while the saving effected by their ultimate adoption would obviously be reckoned by millions, and might probably be sufficient to convert an impracticable scheme into a useful and profitable undertaking.

I will now pass on to the second form of dock, that known as the *Gridiron Depositing Dock*. The advantage of this form of dock is, that it lifts the vessel completely out of water and deposits it on a staging

¹ Figs. 6, 7, 14, 16, 17, taken by permission from "Engineering."

of timber, where it is fully exposed to sun and air, and is in the most convenient position for cleaning, painting, and repairs. The dock is then ready to lift another vessel in a similar manner, so that the number of vessels that can be raised by a single dock is only limited by the extent of staging that may be provided. It is therefore specially adapted for large naval or commercial stations where a large number of vessels are likely to be under repair at one time, or for a naval arsenal, where it might be desired to lay up a number of gun-boats or other vessels in order to preserve them from the decay which so rapidly takes place when they are kept constantly in water.

This form of dock is not so well suited to withstand rough weather as the tubular dock, and as the level of the platforms is necessarily fixed, it can only be used at one certain height of tide, subject to variations of a few feet which can be adjusted by blocking, &c. Its site must therefore of necessity be located within a wet dock or river, or in a sheltered creek or harbour where there is no great rise and fall of tide.

The principle on which it is constructed is at once seen on reference to Fig. 8, by which it will be observed that the body of the dock is not a continuous structure, but is composed of a number of pontoons or fingers B, B, B, across which the vessel lies. The staging on which the vessel is to be deposited also consists of a gridiron of timber piling-work, fixed at distances corresponding to the intervals between the pontoons, so that the pontoons can float in between the piles, and carry the vessel over them; on lowering the pontoons slightly the vessel rests on the piles, and the pontoons can be withdrawn, leaving the vessel on the staging, as shown in Fig. 11. The pontoons are all connected together at one end to a strong box girder-like structure, termed the side of the dock, A, A, A; the dock in fact somewhat resembles a comb, the girder forming the back, and the pontoons the teeth, as in Fig. 8.¹

The pontoons are of boiler plate, and have an oblong section, and are fixed at distances apart of about 3 ft. 6 in., leaving sufficient space for the timber piles of the stage, and for clearway. Their breadth may be ten or twelve feet or more; they are each divided internally into about six water-tight compartments, separated by iron bulkheads, which give strength and stiffness to the pontoon; they are also further strengthened within by an elaborate system of angle-iron struts, both horizontally and vertically, which enable them to support the very considerable external pressure to which they are subjected when fully submerged in the water. The depth of the pontoons is such as is demanded by the floating power of the dock, commonly from twelve to eighteen feet; the side of the dock, which unites them all together, runs the whole length of the dock, and is divided into compartments by bulkheads, and stiffened within by angle-irons in the same manner as the pontoons, or it may be constructed of vertical tubes. It contains the engines, boilers, and pumping machinery, and its function is not only to unite the pontoons together, but also to control the flotation of the dock when the pontoons are submerged ready to receive

¹ The Institution is indebted to the Institution of Naval Architects for a transfer of Figs. 8—13.

a vessel; its height is therefore necessarily fully double that of the pontoons, and when sunk to its lowest level it has a clear freeboard of about six feet; the top is provided with railings, and forms a convenient platform, as in Figs. 9 and 10, about twelve feet broad, for controlling and working the dock. The cross section of the dock therefore resembles the letter L, as in the Figs., and although stable enough when the pontoons are above water with or without a vessel upon it, has no tendency to retain its horizontal position when the pontoons are submerged, as in Fig. 9.

This necessary condition is effected by what is called the *outrigger*, which is shown in Figs. 9 and 10. It consists of a flat-bottom, shallow, but very broad pontoon, which runs the whole length of the dock, and may be either in one or two pieces, or divided into several independent lengths; it is ballasted with concrete so as to float about half its depth in the water; the dock is connected with this by a number of stout booms arranged in pairs, one above and one below. Each pair acts like a parallel ruler, being jointed at the one end to the back side of the dock, and at the other end to uprights attached to the outrigger; they remain parallel at all times, and although they allow the dock to ascend and descend freely, they maintain it always in a horizontal position. The arrangement will be better understood by reference to Figs. 9 and 10. Fig. 9 shows the dock lowered and a vessel brought into position over it ready to be raised; Fig. 10 shows the vessel raised on the dock, and Fig. 11 shows the vessel deposited on the staging. Fig. 12 shows a cradle which allows of any amount of shoring to meet special cases. There is no necessity to use a cradle as a rule, but one could be as easily used as not, should there be any preference in the matter.

As the outrigger is very broad and heavily ballasted, the force necessary to turn it over would be enormous, but it is not intended that any considerable portion of this force should ever be brought into operation; the outrigger acts primarily as an indicator, and when in the act of docking a vessel it shows any tendency to careen over in either direction, it is corrected by so adjusting the valves and the working of the pumps as to keep it at all times level. The whole of the compartments in the dock (which are very numerous) are connected by separate pipes and valves, which are all brought to one common centre, under the charge of a superintendent, who is provided with a spirit level and a series of indicators to show the quantity of water in each compartment. By proper manipulation of the valves and pumps he has no difficulty in preserving the level position at all times. It may be proper to mention here that instead of connecting the dock and outrigger by parallel booms, an equally efficient connection may be made by vertical T-shaped irons on the outrigger sliding up and down in corresponding grooves on the side of the dock, the head of the T being completely clasped within the groove pieces.

The depositing dock is made in two independent halves, each complete in itself as a small dock. These halves can be arranged as in Fig. 13, which shows the depositing dock as adapted for lifting circular ironclads of large diameter, and represents the large dock now being

constructed for the Russian Government at Nicolaieff: this dock is equally adapted for receiving circular vessels or ironclads of the ordinary form.

The blocking used on this dock is the same as that previously described for the tubular floating dock, that is to say, keel blocks for the principal weight, and bilge blocks and air cushions to support the sides of the vessels; these air cushions are not so numerous as in the ship-float, and there are about twice as many on the outside of the pontoons as on the inner side next the dock, the object being to press the vessel well inwards against the dock.

As regards the question of stability, the dock may be considered in three principal positions, viz., at its highest floating level, at its lowest level, and in its intermediate positions; disregarding for the time all assistance given by the outrigger.

When fully afloat, it is simply a pontoon of unusual breadth, and its stability is perfect; when at its lowest position with the vessel bearing on it, the vessel and the side of the dock form a connected pair, any lateral rolling can only occur by the vessel sinking deeper in the water and the side of the dock rising out of it, or the reverse movement, and when we consider the large areas of displacement that come into play, we again find superabundant stability, a rolling movement is simply impossible. The same is true of all intermediate positions, except at the one critical point before pointed out, when the keel is just out of the water; at this point a considerable rise or fall of the vessel might take place without sensibly changing the area of immersion, but at this point the air bags come into full operation, as shown in Fig. 3, and their displacement with that of the blocking on the one hand, balanced by the side of the dock on the other, give ample margin of stability. One further observation on this point is necessary; looking at the transverse section of the vessel and dock as shown at Fig. 10, it is almost impossible to avoid the feeling that the lifting power of the side of the dock must be so greatly in excess of that of the pontoons that there must be a tendency for the side to rise too fast and to throw the vessel off the dock, and there is no fallacy in this supposition; such an effect might be easily produced if desired, but as a matter of practice the lifting power of the side is not brought into use, the pumping is all done from the pontoons; the whole lifting power is produced by them alone, they support the whole weight, and as they rise they carry up the side with them, and the water flows out by gravity alone, the buoyancy of the hermetically closed chambers in the side being only just sufficient to support its weight.

The gridiron staging which receives the vessels when lifted, may be conveniently arranged along a sloping shore; no depth of water is required beyond that sufficient to float the pontoons, although where the vessel is lifted and lowered there must be a depth equal to the draught of the vessel plus the depth of the pontoons. The supporting piles may be driven as close together as is required, or may be made in double rows bolted together if an extra bearing be advisable; in some cases an iron platform might be found necessary. The dock, as before stated, is constructed in two halves, each complete in itself, with

engines, pumps, and moorings; one great advantage of this is that one-half may dock the other half for purposes of cleaning and repair, which can be effected with great facility as every part is thus made accessible. The rigidity of the whole structure is so great that no inequality of pumping could cause any sensible distortion of form, or any strain upon a vessel resting on the dock. In fact this never occurs even in the shallow pontoons used with hydraulic docks.

We now come to the question of the places where the necessity for such docks would be most felt in time of war.

In a paper read before the Royal Colonial Institute by Captain J. C. R. Colomb, R.M.A., in 1873, it was pointed out that the general defence of the empire must necessarily be based on the protection of certain great lines of communication with our colonies. These are :—

1. To British North America, across the Atlantic.
2. To the West Indies.
3. To India, China, and Australasia, round the Cape.
4. To Australasia and the Pacific, round Cape Horn.
5. To India and Australasia, *via* the Suez Canal.

The bases from which these important lines would be defended would be, as far as possible, those which are used as commercial centres in time of peace, and these are divided by Captain Colomb into two groups, viz. :—

1st. Fleet-centres, provided with permanent defences, coaling stations, and docks, capable of repairing the largest class of war vessels. These would include :—

England,
Halifax,
Bermuda,
Simon's Bay,
Bombay,
Sydney,
Hong Kong,
Vancouver's Island,

of which Simon's Bay is at present unprovided with a dock, those at Vancouver's have only just been commenced. As the docks at most of the other stations are constructed solely for purposes of commerce, they would prove somewhat inefficient in time of war.

2nd. Squadron-centres, provided with fortified coaling-stations and docks of smaller capacity, capable of being removed in time of peace, and employed at commercial ports.

The principal stations in this class, as given by Captain Colomb, are :—

Jamaica,
St. Helena,
Mauritius,
Singapore,
King George's Sound,
Falkland Islands,

of which Mauritius and Singapore only are as yet provided with docks.

For Simon's Bay, a dock capable of receiving vessels of 4,000 or 5,000 tons would be required, and the depositing dock would probably be the most suitable for this position, as the work to be done would be at all times considerable, and would be especially so in time of war. The depositing dock would also be the most suitable for Jamaica, where it would be far more than self-supporting at all times. At the other Squadron-centres, the tubular docks would be the best, as they could be removed to any position required during peace, and in war could be towed for use into shallows out of reach of attack.

Jamaica is evidently one of the most important of the squadron-stations, and the want of docking accommodation has long been felt there. A few years ago, a company was formed for the purpose of erecting a dock there, and the greater part of the capital was subscribed in the island, but not sufficient to justify the commencement of the work. With a little encouragement from the British Government, this might, probably, be again arranged, as the estimated profits are very large. If a ship-canal were to be cut through the Isthmus of Panama, it would greatly increase the necessity for a dock at this station.

As regards the cost of docking-accommodation, if we take for the Fleet-centres not yet supplied, a depositing dock, and three lengths of staging each sufficiently large to receive vessels having a dead weight of 6,000 tons (this would be accommodation for four vessels), and for the Squadron-centres a tubular dock for vessels weighing up to 4,000 tons, the following would be, approximately, the cost of the proposed docks :—

Fleet-centre.	Weight of Vessel.	Approximate cost.
Simon's Bay	6,000 tons	£180,000
Squadron-centres.		
Jamaica	4,000 ,,	82,500
St. Helena	4,000 ,,	82,500
King George's Sound	4,000 ,,	82,500
Falkland Islands	4,000 ,,	82,500
		£510,000

Or should these docks be thought to give insufficient accommodation, let us take for the Fleet-centres a dock capable of accommodating vessels weighing as much as 10,000 tons, and for the Squadron-centres a dock for vessels weighing 6,000 tons, the cost would then be approximately as follows :—

Fleet-centre.	Weight of Vessel.	Approximate cost.
Simon's Bay	10,000 tons	£276,000
Squadron-centres.		
Jamaica	6,000 ,,	121,000
St. Helena	6,000 ,,	121,000
King George's Sound	6,000 ,,	121,000
Falkland Islands.....	6,000 ,,	121,000
		£760,000

Sufficient docking accommodation for these centres might, therefore, be provided for about £760,000.

We have not proposed to provide for the very heaviest war vessels afloat, as it is assumed these would rather be employed nearer home, large vessels being designed for offensive warfare rather than for the protection of commerce.

Moreover, as this country would alone hold all the principal coaling stations in these routes, other nations would not risk their larger vessels in these distant stations where coal would not be obtainable; we should therefore have nothing to fear from the presence of any vessels more powerful than our own.

In a naval war it would be essential that our main lines of communication should be protected and provided with fortified coaling stations and means of repair. If through false economy there should be neglect of these precautions, the loss to the country would during each week of interruption far exceed the whole cost of the necessary establishments.

If these coaling and repairing stations be not provided, it is obvious that our costly ironclads would be powerless for continued action at these vast distances from England. A comparatively slight accident which might with proper appliances be readily repaired on the spot, would for the time being, practically extinguish her from the Navy-List, and compel her to leave her station unprotected while she would have to perform a tedious voyage home in a disabled state, and at the risk of capture from much inferior craft.

It may be objected that the country and the colonies would not readily sanction the expenditure of a large sum for the provision of naval stations, which may possibly never be required for Imperial purposes, and there are unhappily to be found many who having lived in security all their lives, and having never considered to what that security has been due, would gladly continue to trust to the chapter of accidents and the forbearance of other nations; but it must be obvious even to these that the proper view to take of such expenditure, is to consider it as an *insurance of the commerce* protected by it, in which light even the most inveterate peace lovers will not object to its principle.

The whole exports and imports of Great Britain have been estimated at about £655,000,000 per annum, and if we add to this the value of the intercolonial commerce, it is probable that the total might approach one thousand millions sterling per annum, irrespective of the value of the ships by which it is carried. By far the greater part of this would be dependent on the Navy for protection during war.

It has been calculated that if we were even to lose the control of the Great Equatorial Mid-Atlantic routes in 23° West long.,¹ as was the case with the United States during the cruise of the "Alabama," the loss to the country would be about £340,000 per diem. In comparison with such figures as these, the cost of protection is altogether insignificant; but its necessity becomes imperative, and the only real problem

¹ "The Distribution of our War Forces," by Capt. J. C. R. Colomb, R.M.A., *Journal of the Royal United Service Institution*, vol. xiii, p. 37 *et seq.*, January, 1869.

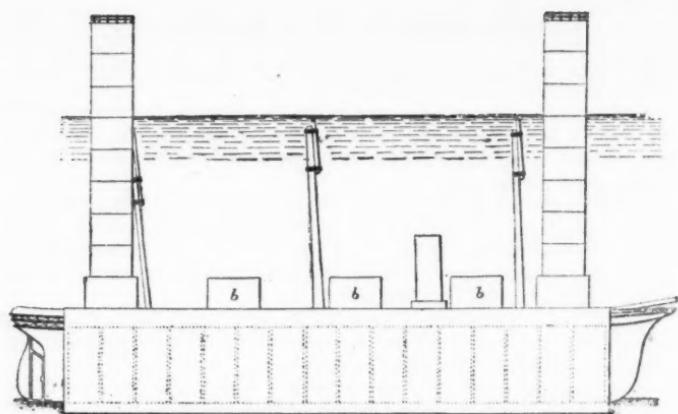


Fig. 14.

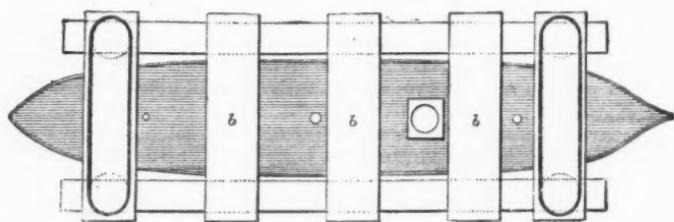


Fig. 15.

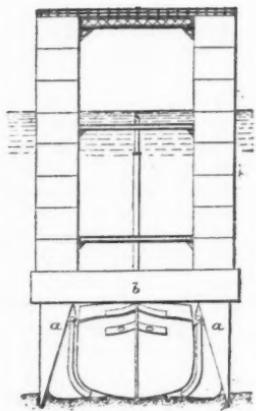


Fig. 16.

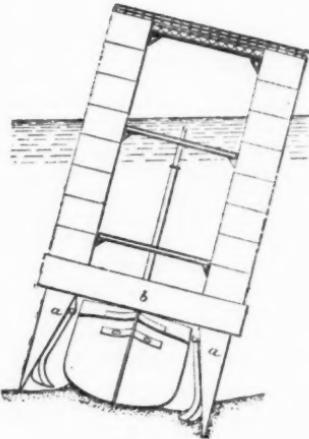


Fig. 17.

remaining to be solved is, how to apportion the amount required most equitably among those who will derive the primary benefit from it.

Before closing this paper, I should like to add a few remarks on the subject of an apparatus for raising sunken ships, which is shown in Figs. 14, 15, 16, and 17. In our old naval engagements we know it was a very usual thing for a great many vessels to go to the bottom, and I do not know that the modern system of torpedo warfare is at all calculated to diminish the number; therefore it has been thought that it would be very desirable, if it could be managed, to regain those vessels, and for that purpose Mr. Standfield and myself have designed a form of dock suitable for lifting them. It is quite evident that if these vessels were simply ordinary boats there would be no hesitation about making a machine which would go down and pick them up with the greatest ease; for if we imagine a human being of sufficient size to reach them with his arms, and to put his fingers underneath, he could lift up vessels of that size. We have endeavoured to deal with the sunken vessels in a similar manner, and for that purpose we have designed a dock, the construction of which you will understand on reference to the diagrams. It has within it, along each side, a number of hollow grapnels or clips, constructed of boiler plate, which come out beneath the bilges of the ship, and lay hold of it. These grapnels or hooks are thrust forward by the inflation of large air-bags behind them, Fig. 16. In using the dock, it would be floated over the vessel, and if the masts were above water they would be cut off a little below, so that the dock might pass over them. It would then be gradually lowered over the vessel, and if the masts and funnel are still standing they would pass through the openings of the dock, as in Figs. 14 and 15. Then if there is any sand accumulated, or the vessel is to some extent embedded, as in Fig. 17, the sand would be thrown out by violently ejecting streams of water from a great number of holes; by turning on a large reservoir of compressed air a tremendous swirl of water and sand would be made, and a clear space would be obtained, and a single pair of nippers would then be forced forward. Then the sand in another space would be driven out, and another pair of clips made to grip the vessel, and so on, until perhaps thirty or forty pairs have been adjusted, and the vessel is entirely gripped in this manner. Last of all, air is ejected from the dock itself, and the buoyancy will then be sufficient to raise the vessel to the surface, and in that state the dock and vessel would be towed away and deposited in shallow water. After an action I think it is extremely possible a very large number of vessels, both of the enemy's and our own, might be quickly repaired and again brought into use.

It may not be a very long distant future when it will be worth considering whether some machine of this kind might not be a very profitable investment, for if only two vessels were recovered it would be a good speculation, and if half-a-dozen were recovered it would be a large saving.

The distance apart of the sides, *aa*, is adjustable, and also the positions of the transverse girders, *bb*, in order to accommodate vessels of

various sizes, and with different positions of masts and funnel. The vertical cylinders, which contain the engines and pumping machinery, are never quite submerged. The sides of the dock contain passag^{es} for communication all round below; the passages are lighted by large bull's-eyes on the inner side, and the workers are under no pressure, and can therefore work speedily and effectively.

I may add that the end air-bags have no grappnels on them, but simply come up to the ends of the vessel and take exactly their shape. They do not grip so much as the other bags, but lift up bodily.¹

The CHAIRMAN: I am sure we are extremely obliged to Mr. Latimer Clark for his interesting paper. I would ask Mr. Scott Russell to be good enough to give us any remarks he has to make.

Mr. SCOTT RUSSELL, F.R.S.: Sir, the only right I should have to say a word on the subject is this, that I am aware of the extent to which Mr. Clark and his friends have carried this subject practically of raising ships that want repairing out of water and putting them into places where they can conveniently have that repair. I also will venture to say I esteem very highly the advantage to the Government of the British Empire of having, at a moderate number of convenient stations on the ocean, places where ships belonging to the British Empire may in the first place, in case of accident, have their repairs, and in the second place may have their supplies of fuel, and in the third place may have protection at moments when circumstances render them unable to protect themselves. I think these are three conditions with which the men who are charged with the interests of the British Empire ought to occupy themselves in the time of peace rather than in the time of war. As, therefore, this is the time of peace as regards our own country and not yet the time of war, we can still occupy ourselves with this subject. Capt. Colombe has shown how necessary it has become to the British Empire to have points of protection and points of supply, and now this paper has spoken of the points of repair, where great advantage may be derived from possessing forethought, convenience, and accommodation. With regard to the particular mode of supplying these, which Mr. Clark and his friends are well known to have provided very ably, I can only say that the experience they have had is of very great value. I have also seen in Russia other modes of supplying these conveniences to their fleets. I think I can see some gentlemen here, Englishmen, who have supplied to the Russians modes of giving their fleets convenient repairs in different parts of the world. I think also I have seen in England methods for giving the inhabitants of other countries—Spain—modes of very cheaply and easily repairing their large ships of war; I have also seen in France a great variety of modes by which the distant colonies are supplied with the means of repairing their ships. I do not think I need say any more about it, because I think these gentlemen are here, and we shall have the advantage of their knowledge. I think we cannot be too much indebted to such men as the Chairman and the reader of this paper for giving us all this information beforehand, and may I add to Capt. Colombe for his admirable papers giving us all this warning beforehand, when it is most disagreeable to the English to hear it, instead of giving it afterward, when it is too late to be of any use to them. I have had a long conversation this evening with a distinguished sailor and member of this Institution, who has told me what very great difficulty there is at the Cape of Good Hope and in that vicinity in obtaining proper supplies of coal, proper shelter for ships, proper protection, and, in case of war, proper means of repair. He has also informed me that in the neighbourhood of that very Cape of Good Hope there are large stores of coal supplied to us by nature; that there are plentiful ports of shelter supplied to us by nature, and yet ships of mine have got there into the greatest difficulties from want of exactly those things which could easily be supplied to them. I say that at such a point, so critical to the dominion of England in the East, and so critical to

¹ A paper on this subject was read before the Institution of Naval Architects on 23rd March, 1877.

her commerce in case of difficulty, that at such places such supplies and such foresight should be wanting is a terrible imputation on the foresight and forethought of the Government of England. Allow me then to say, I think that docks of such a kind as these, that docks of such a kind as I have told you the Russians and Spaniards and French have provided for their harbours, are probably the very cheapest, most convenient, and most expeditiously provided means which the Government of England could supply to the great stations, which I hope the Government of England have already selected and have already provided with some of the necessary means both of defence, and of convenience, and of supply; to those great stations among the colonies of the world, and to the great centres of the empire of England on the oceans of the world, which are to all Englishmen among the most important of our possessions. I think therefore we are extremely indebted to the reader of this paper for the light he has thrown upon the subject, and for having told us, and told our Government through this meeting, that if they care about the colonies, if they care about the commerce of England, if they care about the security of the Empire, if they care about providing beforehand against the destruction of our colonies and our commerce, they have ample means in their power for carrying that care into effect.

Mr. G. B. RENNIE, C.E.: I do not know that I can add very much to the information of the meeting, but our firm have done a good deal in the way of floating-docks of what Mr. Latimer Clark calls the ordinary rectangular form. The first form that was introduced in this country, I believe, of floating docks of iron was of that particular form, and they have been very successful. I do not quite agree with Mr. Clark as regards the particular form he proposes in what he calls the tubular dock, when he says the tubular form is lighter, stronger, and less costly than the ordinary rectangular form. We, on many occasions, have got out different designs for docks of a tubular form very much resembling Mr. Clark's design, but we have always found that the cost has been more, in order to get the same strength and displacement. The new parts which I see in this arrangement are those peculiar air-bags under the ship. I do not exactly know what experience Mr. Clark has had in this work, but there seems to me some difficulty when the vessel is docked as to how the repairs could be efficiently carried out. Of course you could take the bags away one by one and repair at that particular place. Their forms put one in mind of the camels that you see in the old Dutch works used for transporting ships over shallows into the sea; they were very much of that form, but made of light wood; pumps were applied to them; they were pumped out and the ships lifted, then transported into deep water, then the water was let in and the vessel allowed to float. I think from what I understood from Mr. Clark that the dock at Nicolaieff has not yet been completed?

Mr. CLARK: It is partly completed.

Mr. RENNIE: There has been no trial?

Mr. CLARK: No.

Mr. RENNIE: It seems to me that the arrangement proposed for lifting vessels by means of air-bags is a most ingenious one, and one would like to see it practically used in some way; it is perfectly new as far as I know. I am sure all the profession ought to be very much indebted to Mr. Clark for bringing this subject as well as that of floating docks forward, for it is a very difficult thing to persuade governments to spend money in floating docks. I have been looking over some letters to-day so long ago as 1865, when the Duke of Somerset was First Lord of the Admiralty. We tried to persuade his Grace to have docks in a variety of stations, and a few years afterwards it was eventually settled to have a dock at Bermuda. I only hope that Mr. Clark will be successful in bringing this prominently before the public, and in such a way as to persuade the public to have docks at these particular places mentioned in his paper; and it seems to me that there are a great many more stations where they might be useful. I think Gibraltar has no docking accommodation at all, and there is a most suitable place for floating docks of some kind inside the new mole.

Captain J. C. R. COLOMB, R.M.A.: I was in hopes somebody more competent to deal with the special question before the meeting than I am would have risen, but still I wish to make one or two remarks. I must express my very great regret that

there should be such a small attendance to consider a very important subject. The truth is, if it had been anything to take away life, if the torpedo had been the subject of the lecture or anything of that description, the place would have been full. This, however, is a matter not only for saving human life, but for saving the life of the Empire, because the means of repair for our commerce, and for those ships which must protect it, is a most vital point. I should have thought the very fact of the Suez Canal, being in the title of the paper, would have induced others to come to listen to it. Although it is not connected with the subject before us, I should like to say a word with respect to telegraphs, especially as the point was introduced. I understand that the Royal Geographical Society are most anxious to run a telegraph from Alexandria to the Cape. Now, Sir, this is a Naval and Military Institution, and I wish to say what I think the naval and military objection to that plan is. It seems to me, as the lecturer has mentioned, that the importance of our holding the South Pacific, that the maintenance of the two great routes round the two great Capes, is a matter of the most vital importance to the British Empire, and therefore any point in that ocean is a matter of great strategic value. If a line of telegraph is to run from Alexandria down the East Coast of Africa and through the Bush, it is open to this objection, that we leave St. Helena, one of the most vital spots, wholly without telegraphic communication; therefore, as a naval and military question, you must double your telegraph line. There is another strategic objection to that plan, I think, which is this, that if a line is carried, as proposed by the Royal Geographical Society, from Alexandria down through the Bush, without entering into any question of how it is to be maintained through a very barbarous country, I think for another strategic reason it is bad, and I mention it here, namely, that we are putting all our telegraph eggs into the basket of the Mediterranean, and a force operating at Alexandria cutting one cable will cut all, and you therefore do the very thing you do not want to do—you mix up your Cape arrangements with your Suez Canal arrangements, and the true value of the Cape route is as an alternative route. Therefore, I do wish to draw public attention to that fact, for I hope in dealing with a telegraph line to the Cape they will pay some little attention to the strategical, naval, and military importance of connecting a station like St. Helens with the Cape by telegraph and by an alternative route.

Mr. SCOTT RUSSELL: Have we not a St. Helena-Cape-telegraph route at present?

Captain COLOMB: No; you might lose five ships out of six there, and you would not know it till chance brought you word by steamer. With regard to the particular subject before us, the Ship Canal at Panama, I wish to mention that to my certain knowledge along that coast there are many rivers in which, if you could only get over the bar, there is a great depth of water for many miles, and therefore at that point these docks would create a great naval power, and might render fortifications in some places almost unnecessary. I heartily concur in what the lecturer has stated with regard to the unlikelihood of other nations risking their large vessels very far away from the waters of Europe if we hold the coaling stations; but it must be remembered that a coaling-place like Rio, being neutral, involves our sending in war large vessels as a fleet of observation to check the probability of other vessels getting coals there. With regard to the question of the English Government spending money, I would really like to have recorded in the discussion the apparent ignorance there is with regard to the enormous development of our commerce. Between 1866 and 1875 inclusive, the value of the imperial commerce has increased, that is the value of imports and exports only, by 120 millions a-year—that is to say it is 120 millions more in 1875 than in 1866. Supposing, therefore, as an engineering point, on which of course I am incapable of speaking, that these docks are effective and efficient, I ask anybody, is it not worth while to make ourselves safe, even at the cost of a million or two, where our commerce is increasing at that rate, and, as the lecturer has pointed out, the value of our imperial commerce has approached £1,000,000,000. And we are not going to stop at 1,000 millions, because if trade declines in England, the Colonies are developing. For instance, at Cape Colony in 1871 the imports and exports were 6 millions; but in 1874 they were 10 millions. Then in New South Wales in 1870 it was 15 millions a-year, and in 1875 it is 27 millions. Now with regard to the particular point of the places for docks. We have a dock at Bermuda, and it was pointed out in this Institution by Sir William

Hall that it was the very worst place to have a dock. The dock is only 333 feet long; it would not take the "Warrior" or the "Inconstant." The French have the best dock in the West Indies, (and their possessions bear no comparison to ours;) for at Martinique they have a dock 420 feet long, whereas we have none except at Bermuda.

Mr. RENNIE: A stone dock?

Captain COLOMB: I know it is a first-rate dock, for I have spoken with French Officers who have been there, and they tell me they can dock vessels of 400 feet long. I won't take all the great lines of communication, but when we consider that round the great bastion of the world, the Cape, there is no dock, I must say that whatever the expenses might be, we are bound to make one, and, therefore, any invention that will make us a dock more cheaply is of course most valuable, and should receive the attention of the Government. We have no dock, the whole way from Sydney, a distance of 13,000 miles. At Malta we have three docks, and an hydraulic lift; the longest dock is 468 feet in length, and 32½ deep. The next best dock is at Constantinople. At Suez there is a dock 415 feet long, and at Alexandria one 235 feet long. At Bombay we have nine docks. We have numbers of docks on one particular line, but we are leaving our other lines without any docks at all. The reason is that public opinion will look no further than Europe, and we shall be very much astonished to find some day that other powers are not confining their attention to Europe, and that we shall have to fight for everything everywhere that belongs to us, and that if we have not these docks, these means of repair, and our coaling depôts defended, I do not know what is to become of the British empire. For, let our Officers be ever so able, and our ships ever so splendid, I cannot see how on earth the British Fleet is to keep the sea. May I allude to one more point to show how little warning we take. If we turn to the Select Committee's report of the Army before Sebastopol, we find such a thing happened as this. We find the Admiral writing home in these words: "The departure of the expedition for the Crimea and the 'whole military forces affords me leisure to represent to the Lords Commissioners of the Admiralty the very great want of a receiving ship at Constantinople for invalids and supernumeraries, with an experienced master, surgeon, a sergeant's guard of marines, three good warrant Officers, and a small gang of artificers and mechanics * * * Had I a small body of English workmen at my disposal under proper supervision, great delay and expense might be avoided." This letter was dated 8th September, 1854. Now what happened? We were then engaged in a great war, and we naturally required on the spot the means of repairing our ships. The minute made by the Board on that application of Admiral Boxer's was as follows:—"Inform the Admiral that the service being temporary, the Board are not prepared to send out a receiving ship with such an establishment." Then on the 20th of November Admiral Boxer again writes: "The Turkish authorities at my request * * * placed at my disposal a large range of buildings * * * as a dépôt for naval stores and provisions. I beg to report * * * Having constant demands on me to repair ships of war and transports * * and being without resources of any kind, I consider the present moment, as the late lamentable loss of ships in the Crimea will throw all the necessary repairs on me, a fitting opportunity to respectfully recall their Lordships' earnest attention to my letter of 8th September last." In the end it was granted. But, if we do such things near home in the way of neglecting to provide means of repair, what may we not expect to happen on distant seas?

Mr. SCOTT RUSSELL: I thought probably the reader of the paper would have called our attention to a subject of very great importance, namely, the sending out along with the imperial fleet to some of the stations far away from home, a sort of portable sailing or steam dock, or if you like a sort of mother of the fleet, which mother of the fleet should accompany the fleet and take into it the smaller ships for the purpose of repair. I believe that such things have been designed. I know that I myself have had some communications on this subject, but possibly the Messrs. Rennie, who have their representative here, may know about it better than I do. It is very important, and if they will give us such information as they have, we shall be much obliged to them.

Mr. RENNIE: In answer to Mr. Scott Russell, I may say that self-propelling,

movable, floating docks have been proposed on more than one occasion by ourselves. That is to make a dock of such a form as could be propelled through the water, and at the same time accompany the fleet, and dock them at any convenient place. I do not think it would be a very advisable thing to dock a vessel at sea except in calm weather; the rolling of a ship would of course be very detrimental to a vessel in dock. It is very probable, even with a slight swell, that those cushions that Mr. Clark mentioned to-day might be serviceable. The great difficulty in that kind of dock has always been to get the means of propelling them properly. For instance, you see there a drawing on the wall of a very large structure with two little propellers behind it; I do not think they would be of much advantage in keeping such a structure as that in company with a fleet. The power might perhaps be just enough to move them slowly from one port to another, but I am afraid the great difficulty is to get a propelling force of sufficient power to give sufficient speed to be of much service.

Mr. SCOTT RUSSELL: Perhaps towing might help.

Mr. RENNIE: Towing is a very slow process, and would require very large tugs. As far as I know, I do not think such a dock has ever actually been made.

Mr. STIRLING LACON: We have in the chair the author of what I may call the alternative route, and during this session we have had the honour of having Sir Garnet Wolsley in the chair, who has been called from the War Office to become a member of the Indian Council. He told us that the Council had, by authority, taken into consideration our communications with India. It is not a question of whether the Suez Canal can be blocked up by a ship being sunk in the channel, but half a dozen black fellows coming from any place over the desert, each with a pound of dynamite on his shoulder, and depositing it on the bank of the canal, and exploding it, can block up the canal at any moment along that extent of 90 miles. But what astonished me still more to hear in this Institution was this: that the power of England is not sufficient to blockade the Bosphorus, and Sir Garnet Wolsley is your authority. And you are not able to blockade Port Said. Why? Because in your wisdom you have given up the Ionian Islands, and your nearest coaling station to the Bosphorus is Malta, which is a thousand miles off. Therefore I say how important it is for us to have what Mr. Donald Currie has very properly named an "alternative route." I hope Mr. Donald Currie will give us some information with regard to what has been said in this Institution by a Member of the Cape Parliament and a Member of the Natal Senate, both gentlemen telling us that whatever the mother country will do will be seconded by the Colonies to the best of their ability. With regard to the graving docks at Simon's Bay, there cannot be a difference of opinion upon such a subject. I also wish to ask, with reference to the statement made by the gentleman from Natal, that within 140 miles of the capital of Natal, they have an unlimited supply of coal, superior to any steam coal in England, what does it mean? Natal half-way to India, half-way to New Zealand, half-way to Australia! But I believe there is a drawback. The coast of Natal is a most inhospitable coast, but perhaps Mr. Currie will tell us whether colliers can enter the harbours at Durban and elsewhere, and whether it is possible, if a single line of rail was made, to bring steam coal down to the coast, whether small colliers could carry it at no great distance to the fortified harbour and graving docks which I hope we shall soon see at Simon's Bay.

Captain MACLEAR, R.N.: I should like to ask one or two questions bearing upon this point. One is as to the lasting powers of the dock, which must enter very much into the expense, for all these things do come very much to a question of expense. The figures given by Mr. Clark, amounting altogether to three-quarters of a million, are very small indeed, and even if they were double, regarded as an insurance of our fleet all over the world, it would be well expended. But I should like to know whether this amount represents the total cost, and how these docks will last. We know in a graving dock, after the first outlay, there is very little cost beyond the working expenses. But these floating docks, I take it, would from their exposed position, have constantly to be looked to. Though, even if so, I say that no money could be so well expended. During the last few days an occurrence has taken place which will throw a little light upon the arguments put forward here. We have been told that in the very last part of the world where we could have expected to

find a naval engagement, two of Her Majesty's ships have been engaged. If any day last week we had been asked where we would expect the news of the next naval engagement to come from, the very last place we should have thought of would have been Peru, and yet suddenly we have a telegram to say that the two best ships on the station have gone out and engaged a rebel ironclad. Supposing that the men who manned that rebel or pirate had fought their ironclad successfully, it is quite possible our two best ships in the Pacific might now be *hors de combat*, and I should like to know what means there are of repairing them. There is only the dock at Valparaiso, and I do not know whether the "Shah" can get into that dock; at all events that dock is not our own, and the whole of Peru might be in the hands of the enemy. In that case there is hardly any place where our ships could be repaired. Eastward of the Cape, Melbourne, perhaps, has the best dock, and there is also a dock at Hong Kong. No one knows better than Mr. Donald Currie what we have at the Cape, and the great necessity for a dock there, the turning point of our communications with the East. One word about the telegraph cable, of which I have heard for the first time to-night, and with regard to the route to be pursued. There is a misapprehension, I think, about the difficulty of picking up a cable. A cable can be picked up anywhere. Of course the shallower the water, and closer in shore, the easier, but I do not think there can be the slightest difficulty about vessels picking up Atlantic cables anywhere in mid ocean. As far as these lines to the Cape go, I should most certainly say from what I know of the Atlantic, that the West Coast of Africa would be the best for the telegraph route; taking in the different West Coast colonies, and their communication with St. Vincent, Ascension, St. Helena, and the Cape, it will be by far the most profitable, and also offer the best security for laying down the cable. No doubt the Royal Geographical Society have some reason for their opinion, but I think the route that they propose would be a very dangerous one, as it is thickly studded with coral.

Mr. SCOTT RUSSELL: The West Coast would be not only the easiest route to lay the cable, but possibly the easiest on which to protect it after it was laid.

Captain COLOMB: I should like to add that the slip at Melbourne is a slip 720 feet long, and capable of taking in a vessel of 2,000 tons.

Captain MACLEAR: I know the graving dock will take in the "Nelson," and the ironclads they have there, and they say it will take in our largest ironclads, but I do not know whether it will.

Captain BURGESS: I should like to ask if Mr. Latimer Clark has had any experience with regard to the india-rubber cushions, because I think we have been told in this Institution, that india-rubber is very apt to become deteriorated by sea-water; perhaps Mr. Clark will kindly tell us that.

Mr. LATIMER CLARK: Mr. Rennie made some observations of a technical nature, as to the relative advantages of the tubular and the square form, which it would be impossible for us to discuss with any advantage at this late hour, and in the presence of a meeting like this. He also alluded to the question of the air-bags, which, as he stated, resembled camels. I believe the idea came very much from camels. The Russian Government have used these bags very extensively, and still do so. Quite recently Mr. Standfield saw them using a single large bag 60 feet square, having a vessel with her fore-foot upon it high and dry out of water. They have long been in the habit of using them, and, as far as I could learn from Admiral Popoff and other Russian officers, they last extremely well, especially under water. In fact it surprised Mr. Standfield to see how roughly they used them, and yet how well they appeared to last. As regards my not having suggested Gibraltar as a station, I simply followed Captain Colomb's paper in giving the stations at which he thought docks should be established. I should like it to be understood in indicating the small screws behind the shallow-water-ship-float, that there was not the smallest idea that the dock should ever perform ocean voyages, or attempt to gain any high speed. I stated in the paper that the screws were simply intended to move the dock and vessel from place to place at a moderate speed. With respect to the questions of cost, and of wear and tear, the cost has been estimated in a rough manner, it being intended that the depositing dock should be provided with stages enough for docking three vessels at once, thus including itself, making it equal to four docks; and with respect to the wear and tear, I think the durability would

be about the same as that of an ordinary vessel, that is to say, it would only require painting and cleaning occasionally. There is an arrangement by which every part is accessible, and it can be painted as easily as an ordinary vessel, and therefore I say the duration of these docks would be about the same as that of a ship.

Mr. SCOTT RUSSELL: A ship well built and well taken care of is nearly as good after twenty years' service as when she first started.

Mr. LATIMER-CLARK: As to picking up cables, what I said in the paper was that it was desirable that we should not indicate the exact position where cables were laid, because there might be a variation of a great many miles in the route of a deep sea cable without materially increasing its length, and if the enemy did not know where the cable was laid, but only knew generally that it went, say from Valentia to New York, they would have very great difficulty in finding it; but if they knew its exact position, of course its destruction is an operation of the simplest character.

The CHAIRMAN in summing up said that it was all-important in the arrangement of graving docks or floating docks to have them made in good time, and not to wait until an emergency arose. In war, the want of suitable preparations had lost emperors their crowns, and in the present age it was more than ever necessary to have facilities in naval warfare. With regard to the expense of these proposed floating docks, Mr. Clark had informed him that the expense would be about as great as for graving docks, and he thought that while the floating dock would suit in certain places, the well built solid stone graving dock was more suitable and advantageous generally. He did not see how a floating dock could follow the fleet, as the vessels would be hindered in their speed. The Chairman then explained that in the Cape Colony there was only one port with docks, Cape Town, and showed the necessity for some establishment, permanent or floating, at Simon's Bay, and concluded by thanking Mr. Clark for his paper, in the name of the members present.

Evening Meeting.

Monday, March 26, 1877.

REAR-ADmiral JASPER H. SELWYN in the Chair.

ON RECENT IMPORTANT ECONOMIES IN THE USE OF
FUEL FOR WORKING STEAM-ENGINES, AS ACCOM-
PLISHED BY THE PERKINS' SYSTEM.

By Mr. LOFTUS PERKINS, C.E.

As a prelude to the paper I am about to read, I desire to give my very sincere thanks to your Council, to whose courteous invitation I owe this opportunity of explaining the system of boilers and engines which enable me to use steam more economically than hitherto. In addressing myself to the members of the Royal United Service Institution I feel that I have the advantage of courting the enquiry of men, both practical and scientific, desirous of progress, and who are able and willing to give an impartial hearing. Such an occasion but seldom offers itself to an inventor, "who but usually finds himself prejudged "as a disturber of vested interests or official repose," and whilst profiting by it, I hope you will see that the subject-matter is of sufficient importance to merit attention, and that you will thoroughly discuss and ventilate it. As I may unwittingly be guilty of errors both of omission and commission, I, therefore, in advance desire to express my readiness to give explanations and reply to any questions which members may feel disposed to ask.

Bred in the family belief that in the use of high-pressure must be sought any very material improvement of the steam engine, I have persistently had this end in view, and for years have been perfecting the system I am about to explain.

Starting many years back with a boiler proved to a ton to the inch, with working pressures of from 500 lbs. to 2,000 lbs. to the inch, I proceeded to experiment on and consolidate the connections with the engine.

I then designed several systems of compounding till successful, and introduced new systems of jacketing.

The use of distilled fresh water in the boilers obliged me to devise a new description of surface-condenser, in which I was much aided by Professor Williamson.

The exceptional pressures worked to, necessitated fresh devices for the valve arrangements, for the packing of glands, and these and many other details caused me much trouble and delay.

The cutting of the cylinders, so general at high-pressure, threatened to become an insuperable obstacle to a practical success, but by dint of research, I fortunately found a compound anti-friction metal, which relieved me of all further anxiety on this score.

By the use of this metal and a new system of piston I devised, its effective action in the cylinder was secured, with complete absence of cutting, and yet requiring no lubrication.

These represent the main features of my system, they are protected by many patents, over which I have spent many years and much money.

The system as it is at present, has been some years in practical work, and has fairly satisfied my expectations.

Had I but prejudices to overcome, I should feel very confident of its early and general introduction, but in the vast field which steam-engines occupy, with millions of money invested in their manufacture, the disposition to discourage all inventions likely to disturb the even course of trade becomes actively hostile against so radical a change as the one I desire to introduce.

In making these remarks, it is not my purpose to expose my grievances, but to some extent, to explain away the natural query, "How 'a system which claims so much, and can be practically tested, is 'not extensively adopted?'"

I will now proceed to explain as clearly as I am able, and more in detail, the separate features of the system, in aid of which I have had prepared the different diagrams now hanging on the walls.

I will commence with the boiler, in the construction of which I have but followed the steps of my father and grandfather, both using steam at high pressures—the one for his steam gun, the other for his heating apparatus.

Figs. 1 and 2 on the diagrams, show the construction of the boiler or steam generator. The horizontal tubes are $2\frac{1}{4}$ inches internal, and 3 inches external diameter, excepting the steam collecting tube, which is 4 inches internal, and $5\frac{1}{2}$ inches external diameter.

The horizontal tubes, being welded up at each end half inch thick, are connected by small vertical tubes $\frac{7}{8}$ inch internal, and $1\frac{5}{16}$ inches external diameter.

The fire-box is formed of tubes bent into a rectangular shape, placed at a distance of $1\frac{3}{4}$ inches apart, and connected by numerous small vertical tubes.

The body of the boiler is made of a number of vertical sections composed each of eleven tubes, connected at either end by a vertical tube; these sections are connected at both ends by a vertical tube to

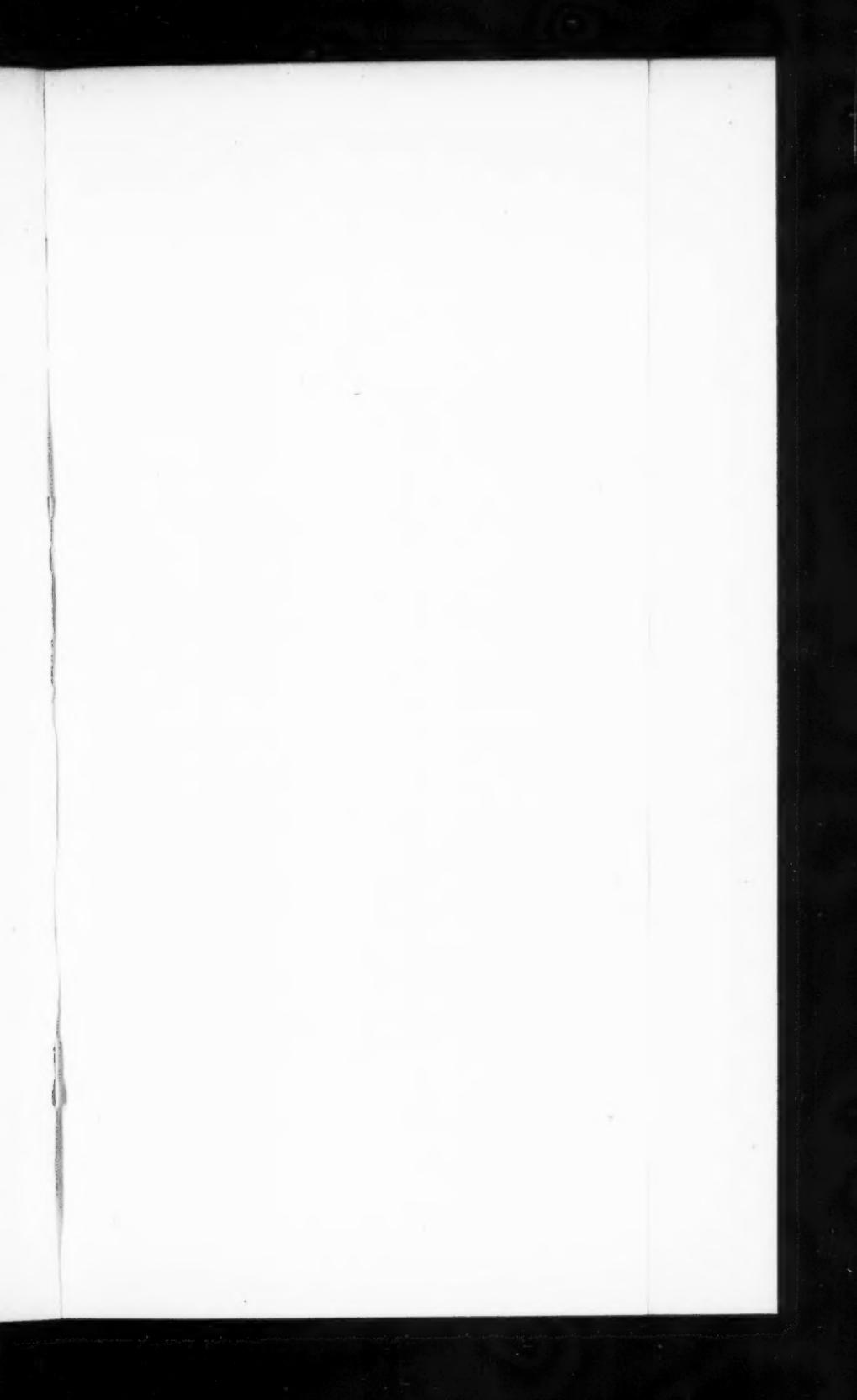
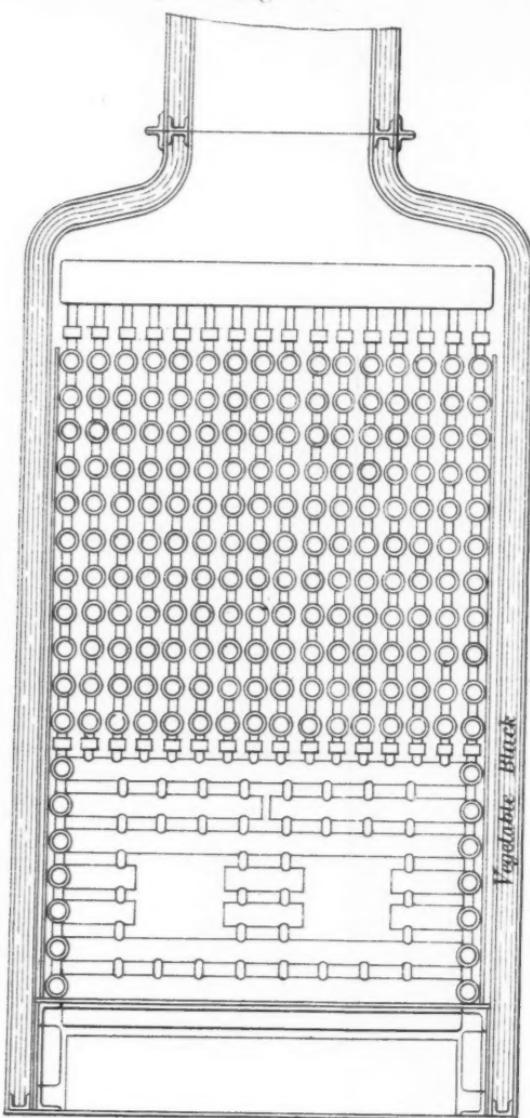
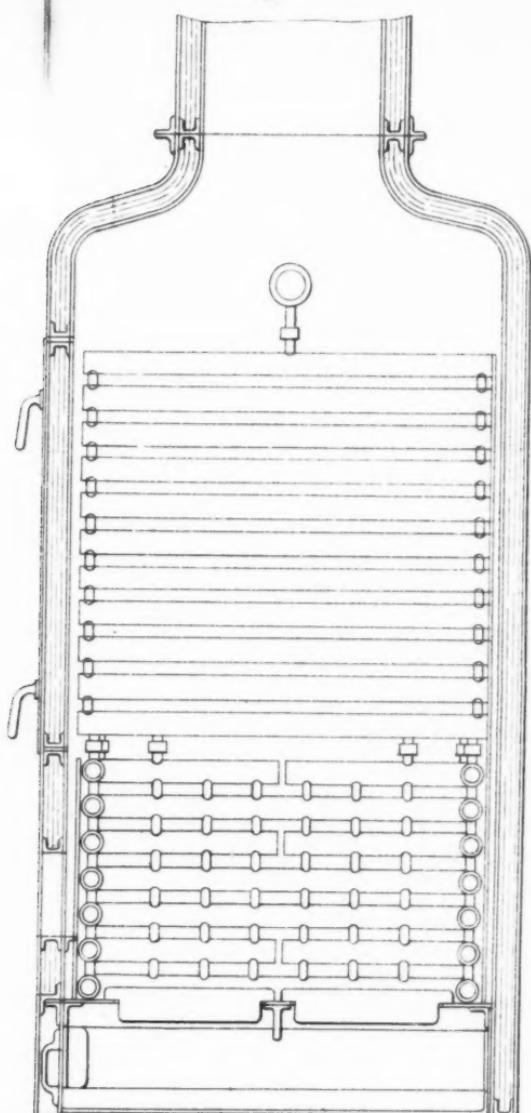


Fig. 2.



Front View.

Fig 1.



Side View

Fig. 5.

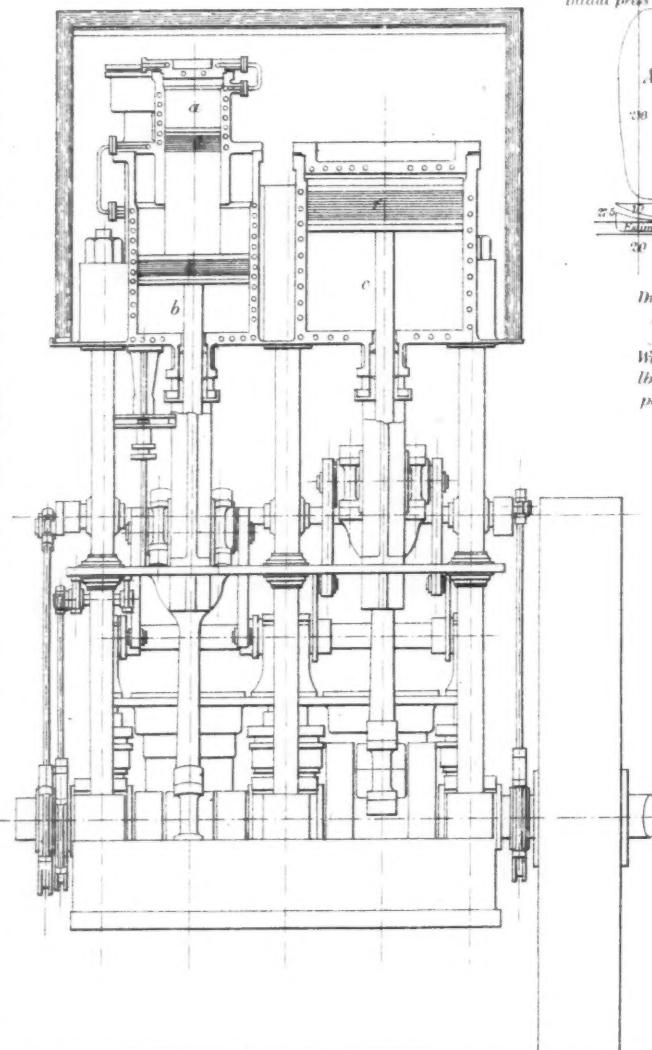


Fig. 6.

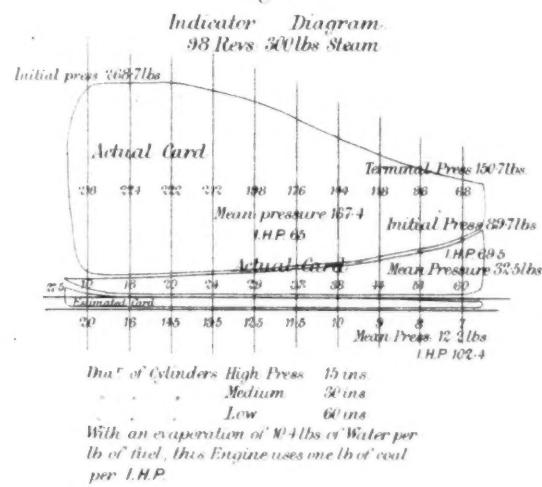


Fig. 4.

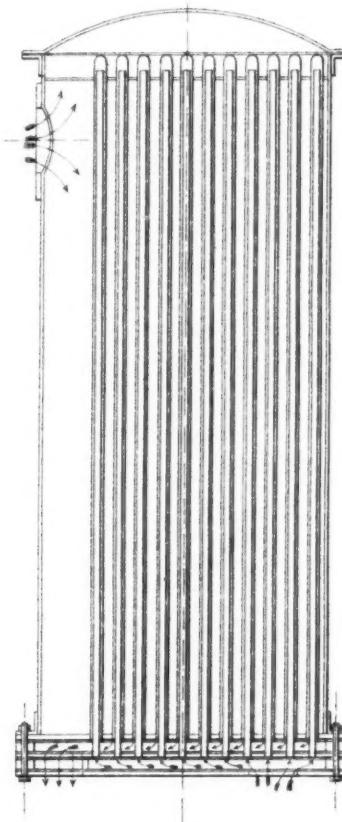
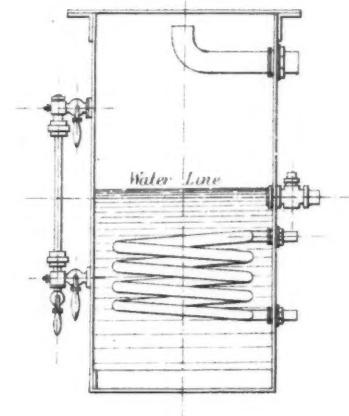


Fig. 3.



the top ring of the fire-box, and by another to the steam-collecting tube.

The whole of the boiler is surrounded by a double casing of thin sheet-iron, filled up with vegetable black to avoid loss of heat. Every tube is separately proved by hydraulic pressure to 4,000 lbs. on the square inch, and the boiler complete to 2,000 lbs., this pressure remaining on for some hours.

Tubes of the same sizes and description have been used by me for many years, for other purposes, at a constant working steam pressure of 2,000 lbs. on the square inch. These boilers, or tubes, when worked under the conditions of the system, show no perceptible deterioration after many years' use.

This statement you may see confirmed in the Report of the Admiralty Boiler Committee of the 19th of September, 1874, when, at their request, I cut open a boiler that had been thirteen years at work; the Committee took several sections therefrom for record, which have been kindly lent to me, and are now on the table for the inspection of the members.

The facts recently brought to light by the distinguished chemist, Professor Barff, of the formation of black or magnetic oxide on iron exposed to high temperatures in the presence of steam may possibly explain the non-corrosion of my boilers.

The report of the Boiler Committee mentioned above was presented to Parliament, on the motion of Mr. Cawley, on the 3rd of May, 1875, and ordered to be printed on the 11th of May in the same year. Thinking some members might be pleased to read the report, I have brought a few copies with me which are now on the table. (See Appendix A.)

It will be observed, that the form of construction of this boiler, admits of almost any area of grate surface, as the boiler can be made broad and low without interfering with its useful action; fuel can, therefore, be consumed as slowly or rapidly as might be deemed expedient. By preference, I employ a moderately slow combustion, with natural draught.

As it takes practically the same amount of fuel to make steam of one or one thousand pounds, and as the higher the pressure the greater the effective expansion, consequently the greater the economy.

This axiom I have always had in view, in constructing a boiler of such strength as to safely contain steam at sufficiently high pressure to admit of effective expansion.

A convenience practical gentlemen present can readily appreciate, is the use of the same boiler, both as to size and power, for every class of ship. They may simply be more or less in number but of precisely similar design; all parts can be interchangable, and ships on distant stations could draw as required from dépôts or consorts, separate parts or complete boilers. These could be fitted up either in harbour or at sea without the necessity of opening up the ships, or even disturbing so much as a plank of their structure.

I shall now make a few remarks as to feed-water for boilers. Here-

tofore it has been the custom in marine engines with surface-condensers, to supply the boilers with sea water or the products of sea water; and difficulties have arisen with the boilers and parts of the engines from rapid deterioration of the exposed metal in both the steam and water spaces. From what cause this deterioration arises has not been hitherto satisfactorily explained, and no efficient remedy has yet been applied. Many plans have been resorted to, and the one generally adopted is to create by varied means a protective scale on the exposed surfaces.

In the Perkins' system the boilers are supplied with fresh water, and no scale is formed.

The whole of the machinery is constructed to avoid all loss of water, and a suitable reserve is carried to make good any waste that does occur. Practically it has been found that this waste can be reduced to so small a quantity, that the stowage of the necessary reserve is not attended with any material inconvenience.

The water before passing into the boiler is evaporated in the distilling apparatus, marked Fig. 3; it then passes into the condenser, Fig. 4, and to the hot well, thence to the boiler. The exhaust steam from the engine is condensed, and the original supply of feed water is thus returned and used over and over again. From time to time only is it supplemented by what may be required to repair the small loss by waste.

No deleterious matter that will injure the iron or create a deposit on the surfaces can enter the steam or water spaces; they remain in their primitive condition, and their efficiency is in no way or at any time, during the life of the ship and engines, impaired either in strength or efficiency.

The immediate economic results, though not more interesting, are more striking when it is observed that by the use of this system of steam machinery, the Royal Navy alone would save at the least 50 per cent. per annum in the cost of its fuel.

I will now draw your attention to the engine, and by the diagram, Fig. 5, you will see the arrangements by which we deal with the high-pressure steam contained in the boiler in order to obtain from it the greatest amount of useful work.

A is a single-acting high-pressure cylinder.

B is a single-acting cylinder of four times the capacity of A.

C is a double-acting cylinder of four times the capacity of B.

D and E are two pistons on the same rod, working in the cylinders A and B.

The course of the steam is as follows:—The steam enters A at 250 lbs. pressure and cuts off at half stroke; at the termination of the stroke it expands into the bottom-end of cylinder B, making the return stroke; it then expands into the opposite end of cylinder B, which is in direct communication with the valve-box of cylinder C. This latter is double-acting, and is arranged to cut off at about quarter stroke, and exhaust into the condenser after the steam has expanded 32 times.

All the cylinders are jacketed with wrought iron tubes, as shown in the diagrams. They are cast in the metal and filled with steam direct from the boiler, the condensed water drained from the jackets being conveyed direct to the hot well.

The whole of the cylinders, valve-boxes, &c., are surrounded with a double case of thin sheet iron, filled in with vegetable black, to prevent the escape of heat and, at the same time, to keep the unjacketed parts at a high temperature.

The ordinary mode of packing the pistons I found unsatisfactory, when working these high-pressure with great expansion, and I was driven to devise the compound piston, as shown in the cylinder drawing at D, E, and F, and by the sample piston on the table.

The liability in compound engines, of the cylinders being scored or cut by the pistons is a source of danger, effectively remedied through the use of my compound metal, of which the piston rings are made.

I have a number of cylinders, which have been several years at work; they have been frequently opened, and show no signs of wear, the wear taking place on the rings only, which have to be renewed as occasion requires.

This metal has been used by several independent makers, with uniform success.

The certificates, in confirmation, I have laid on the table (see Appendix B). One is from the well-known constructors, Messrs. Thornycroft, who state "it is a splendid material for piston rings, as "there is no chance of the cylinders being scored when it is in use; "we supplied it for the piston rings of the torpedo vessels we delivered lately to the French Government, and found we could run the "two hours' trial easily, at the rate of about 430 revolutions per "minute, and without using any oil or grease in the cylinders."

The use of the metal, as shown, saves the cylinders, and, at the same time, is of a nature requiring no lubrication; a material service, as with the temperature of the cylinders raised by the jacketing to about 450 degrees, and, with the high-pressure of the steam, the use of lubricants might have been attended with difficulty.

The piston as devised effectively prevents leakage; and it is suitable for low as well as for high-pressure.

There are many details connected with the minor fittings which have had to be worked out and mastered, in order to achieve the practical results now attained; but I fear I may be thought tedious by entering into them, and will proceed to explain the surface condenser, which is shown in drawing (Fig. 4). It is constructed in such a manner as to be absolutely tight, so as to ensure that the condensing water shall not find its way to or mix with the water from the condensed steam. It is composed of a number of straight tubes, $\frac{7}{8}$ inch internal and $1\frac{1}{8}$ inches external diameter, welded up at one end and fixed securely in a tube-plate at the other end, and fitted with an internal tube open at either end, one being fixed in a division-plate to cause the water to circulate to the extreme end of the tube. The course of the circulating water is marked on the drawing by arrows,

to show the direction of the current. The whole of the tubes are galvanized, both inside and out.

Connected with the surface-condenser is a small independent engine to work the air, circulating, and feed-pumps, the motive power being supplied direct from the main boilers. The whole steam power is thus rendered available should it be required at any moment to drive the main engines, and as all steam escaping from the safety valve, &c., &c., is carried to the condenser, it does away with any necessity for checking the fires.

Diagram Fig. 3 shows a small still, worked by a steam coil; this coil is fed direct from the boiler, and the condensed water from it passes to the hot well in the same manner as the drainage from the cylinder steam-jackets. The water required to replenish waste is passed from the reserve tank into the still, and by means of the coil it is evaporated and passes into the condenser in the shape of steam, where it is condensed and added to the feed supply.

A duplicate apparatus forms part of the equipment of a sea-going ship, to furnish steam from sea water, for blowing the steam whistle, and for all other purposes where steam is allowed to go to waste, or escape into the open air, and also for supplying distilled water for the use of the crew. This can be worked at any suitable pressure.

On reference to the diagrams Fig. 6, the calculated indicated power shows about 1 lb. of coal per horse-power per hour. The diagrams of the high and medium pressures are from the actual working results of the steamer "Filga." Compared with the engines in general use, these diagrams will, I trust, be found interesting; they are not, however, satisfactory to my mind, as I have no doubt that by the use of my most recent improvements, more especially the piston, diagrams showing greater economy could be produced.

It may be remarked that the indicated diagrams by this system can be taken as normal diagrams. They should not vary so long as the engine is maintained in fair working order, as the boilers are always able to support the maximum pressure without risk.

It will not, I hope, be considered invidious, if I compare this result with that of the steam-engines of one of our most recent ironclads, viz., the "Alexandra," which, if reported correctly in the *Times* of the 3rd of March, burnt $2\frac{1}{2}$ lbs.¹ of coal per indicated horse-power per hour on her six hours' trial trip.

The "Alexandra" may, I believe, be taken as representing a type above the average of Her Majesty's ships of war, as regards economy of fuel, and would no doubt compare favourably in this respect with our merchant steamers; but I think there are many here present who must see that if the "Alexandra" were fitted with the boilers and engines I have been describing, consuming 1 lb. of coal per indicated horse-power per hour in place of $2\frac{1}{2}$ lbs., her effective power as a war ship would be greatly enhanced; and this, it may be observed, at no greater outlay of money in her construction.

This question of economy of fuel is equally important both to the Royal and the Mercantile Navy.

¹ For further particulars see Appendix C at the end of the discussion.

At a recent meeting of this Institution, the "Alexandra," when steaming 13 knots per hour, was stated to consume 200 tons of coal per diem, with stowage only for 750 tons. Thus after steaming full speed for less than four days and 1,250 knots, this costly ship must become comparatively helpless.

Presuming such vessels represent the Navy of the future, the system which by your favour I have described, would at all events prolong their active powers by more than double the time and distance.

Reading my paper in this Institution I have concluded especially to address my remarks to the bearing of the system on Her Majesty's Navy, and I shall not here enter into the question of the mercantile marine, where, however, the advantages would, I conceive, be equally striking, though not exactly on the same grounds.

If it be admitted, as I believe it must be, by all who will take the trouble themselves to investigate the subject, that my boilers are at least as long lived as the ships, and that they are safe from explosions of a destructive character, and that they can be made easily interchangeable throughout the entire Navy, then it would show that the enormous cost of renewal of boilers every few years, with the consequent loss of the ship's services during the necessary demurrage, would be entirely saved, that the opening up of the ship's decks would be avoided, whilst with complete security against explosion, the ship's commanding officer would have always under his control the maximum pressure the engine could support.

Whilst summing up these direct advantages of the system, I am desirous of calling the attention of gentlemen present, who may be called on to command Her Majesty's ships in time of war, to what I term "reserve of power." Due prominence has not, I think, been hitherto given to this property, by which I mean "the margin between "the normal working power of the boilers, and the utmost power they "are able to exert with safety." It is controlled by the maximum pressure of the boilers and their capacity for rapidly generating increased volumes of steam, and by the strength of the working parts of the engine.

Vessels of war fitted with the most recent compound engines and boilers, such as in the "Alexandra," when quite new, can probably work up to 70 lbs. pressure on the square inch with safety, but it would not be deemed prudent to raise the pressure much above this point.

As these boilers very rapidly decay, this pressure of 70 lbs. would soon be deemed unsafe and have to be lowered.

Such boilers may be said to have practically no "reserve of power" as the 70 lbs. pressure at the trial-trips speedily falls to 50 lbs., and the possible loss of crew and vessel would be the consequence of reverting to the original pressures.

With vessels of war fitted with boilers on my system working at a permanent pressure of 350 lbs. on the square inch, the margin of "reserve of power" may be taken as not less than a working pressure of 800 lbs. on the square inch, and even then there would still remain a margin of safety many times greater than that of the present type of boilers when new at 70 lbs. on the square inch.

The Perkins' system is worked in its normal condition with natural draught, but on emergency with the aid of the steam-blast, a pressure of 500, 600, or 800 lbs. on the square inch could be quickly attained; as the boilers do not deteriorate by use or age, this reserve of power may be called upon at any moment in the life of the ship at the sole cost of extra fuel.

The reserve of power allows a commander to bring on or avoid an engagement, to elude or overhaul an enemy as desired. It gives extra velocity to a ship, makes her more handy, and would enable her commander to chose the positions most favourable for the use of her aggressive or defensive powers.

I trust, that in laying so much stress on the value of this property for combative purposes, I may not be considered over sanguine, and it will give me great pleasure to hear the opinions of some of the gentlemen present whose duty it may be to take Her Majesty's ships into action.

My boilers, though indestructible in fair ordinary usage, may, of course, come to grief by the enemy's projectiles during an engagement. The vessel, however, would not be directly endangered, and the small amount of steam stored in the boiler would escape up the funnel without explosion in the ordinary sense of the word, and without filling the engine-room and stoke-room. By employing some extra pressure in the remaining boilers, the speed of the ship could be readily recovered and maintained.

Should the damage done to the boiler be only slight and a few tubes only broken or displaced, the boiler could be repaired at sea without having to return to port; or, if spare parts were carried, an entirely new boiler might be fitted up with equal facility at sea.

A very prevalent evil, which hitherto I have not mentioned, is that of priming; its very serious inconveniences are so well known that it is needless I should dwell upon them. My purpose in calling your attention to it, is to state the complete immunity from it by the use of my system. I say advisedly "complete immunity," as I have never had a single instance of priming under any condition of working.

I may here mention a rather crucial test now going on at my works at Seaford Street, Regent Square, where a 50 indicated horse-power stationary engine is working itself by a main steam-pipe but one-eighth of an inch in diameter. If there were the least priming the even working of the engine would at once be interfered with.

This diminutive steam-pipe (some samples of which are on the table) I may add, not only turns the engine but also supplies the jackets.

Should any gentlemen present be desirous of inspecting this engine, I shall have much pleasure in showing it. Some have already seen it, and I am sure they will confirm my statement.

The question of fuel I have, I believe, sufficiently explained. Its importance in warfare must be immense, and a reduction of 50 per cent. in coal should nearly double the efficiency of the Fleet.

I cannot conclude better, I think, than by recalling the expression of one of Her Majesty's Ministers (Mr. Gathorne Hardy), when presiding at the 46th Annual Meeting of this Association, which was as

follows, if correctly reported in the *Times* of the 5th March last. "He
"saw that one of the subjects of this year's Essay was, how to secure
"*a powerful and economical naval force*, and he might remind those
"who were about to enter into the competition, that the question of
"economy lay at the bottom of half our difficulties, because if our
"forces were not administered with the greatest economy, a cold fit
"would come over the nation, and for the sake of saving money, all
"that had been done at large cost might be undone."

I have not laid before you undigested theories nor crude experiments. All my facts I am prepared to prove and show in full practice. My inferences are naturally open to be discussed and controverted; but they are put forth in good faith. I may possibly have erred in giving undue importance to certain points of the system, and if so, some of the gentlemen present will, no doubt, correct me, and I shall be pleased to be put right where in error.

APPENDIX A.

NAVY (PERKINS'S BOILERS).

"Return to an Order of the Honourable the House of Commons, dated 3rd May, 1875 :—for

"Copy of the Report of the Committee on Boilers appointed by the Admiralty,
"dated the 19th day of September, 1874, "on the propriety of constructing En-
"gines and Boilers on Mr. Perkins's Plan for Marine Purposes."
"Admiralty, } THOS. WOOLLEY,
"7th May 1875. } Chief Clerk.

"SIR, "Admiralty, 19th September, 1874.
"I am instructed by the Committee on Boilers to acquaint you, for the information of the Lords Commissioners of the Admiralty, that they have carefully and fully considered the propriety, or otherwise, of constructing engines and boilers on

"Mr. Perkins's plan for marine purposes.
"2. From the official papers which have been placed before the Committee, it is found that in March, 1873, the Yorkshire Engine Company were called upon to forward tenders for engines on Perkins's system for vessels of the 'Daring' and 'Mosquito' classes, of 720 and 360 I.H.P. respectively. In May, 1873, tenders were forwarded accordingly, and after a careful examination of the designs as submitted by the Yorkshire Engine Company, the Engineer in Chief of the Navy considered the disadvantages connected with the engines on this plan were much greater, first cost, greater weight, greater complexity of engines, greater cost of maintenance, and the necessity of having pure water in boilers.

" 3. The matter then remained in abeyance for some months, but in May last attention was again called to this subject, and it appeared from the Yorkshire Engine Company's letter, that they had in their former tender for engines misunderstood the power to be given; and consequently had prepared and forwarded a design for engines of a greater maximum power than was required. The Company shortly afterwards forwarded a revised tender and drawings for engines of 720 I.H.P. for a vessel of the 'Fantome' class, in which the space, weight, and price were reduced. It was then decided that when it became necessary to obtain engines of the power referred to, they should be invited to tender for them.

"4. Thus the matter stood until July last, when a letter from Mr. Bailey, containing printed documents, was laid before this Committee; and it was then decided that, when convenient, the matter should be fully considered in all its bearings, and that as much evidence as possible, for and against, should be obtained.

" 5. The Committee stated, in paragraph 12 of their letter of the 7th August last, as follows:—

" 'The Committee have also had under their careful consideration the plan of engines and boilers on the system proposed by Mr. Perkins, and have inspected the engines on this plan, which are on board the "Emily," a small yacht, while under weigh; and the "Filga," a tug, as well as the engines which are now at work in his factory. The Committee have examined Mr. Perkins, and have applied to him for more specific information relating thereto; and on receiving Mr. Perkins's reply a further communication will be made on the subject.'

" 6. Since that date the Committee, with a view to a more searching investigation of the condition of the boiler and cylinders of the land engine at Mr. Perkins's works, induced him to open out the boiler, and cut open three of the tubes from different levels; and also to open out the cylinders, and have the pistons drawn. This was done in the presence of the Committee, and a strict examination was made of all the working surfaces and the state of the tubes; and samples of the tubes, &c., were obtained.

" 7. The tubes in this boiler had been in use, it was alleged, nearly 13 years; and they were found to be in a remarkable state of preservation; and the piston, packing, and valve rings of the engine, which were of Perkins's Patent Metal, composed of five parts of tin and 16 parts of copper, and which were stated to have been in place, and at work without lubrication 18 months since last examined, were found to be in a similar condition.

" 8. Bearing in mind that the main feature involved in Mr. Perkins's system is the use of soft fresh water, or rain water, over and over again, the waste being supplied by water obtained from a double distilling apparatus; the Committee have directed their attention to some other engines using fresh water, with a view to obtaining as much information as possible on the point referred to.

" 9. They have accordingly obtained evidence in regard to the following engines and boilers with which fresh water is used, observing that it is the general practice to have fresh water in land boilers, viz.:—

" (1.) A land engine at Messrs. Gwynne's works, Essex Street, Strand.

" (2.) A land engine at the works of Messrs. J. Stewart & Co., Isle of Dogs, Blackwall.

" (3.) A land engine at Messrs. Merryweather's, Lambeth.

" (4.) The fire engine boilers at Messrs. Merryweather's and at Messrs. Shand, Mason, & Co.'s.

" (5.) The boilers used for producing steam for warming the Houses of Parliament.

" (6.) And also cases in which attempts have been made to use fresh water at sea in marine boilers.

" The Committee visited these different establishments, and, so far as they could, have examined the boilers and obtained on the spot as much information as possible.

" 10. Although it does not appear that any of the systems at present in use are worked exactly on the same principle as Mr. Perkins adopts, yet the Committee are of opinion that there is an advantage in using soft fresh water in boilers generally; and the favourable opinion which they have formed with regard to the Perkins's system, has thus been so far confirmed.

" 11. The Committee, then, are of opinion that evidence sufficiently satisfactory has been obtained of the working of Perkins's system to enable them to propose to their Lordships that experiments should be made on such a scale as to test its value, with as little loss of time as possible; and they therefore recommend, with the view to thoroughly testing the system in a practical manner, the undermentioned engines, &c., should be obtained, viz.:—

" (1.) A land engine and boiler for use in one of Her Majesty's dockyards.

" (2.) A pair of marine engines and boilers for use in one of the harbour vessels, such as one of the home port tugs.

" (3.) A set of engines and boilers for a small sea-going man-of-war, as proposed by Mr. Wright, Engineer in Chief of the Navy.

" (4.) Also that some vessel at present fitted with compound engines, and about

"to receive new boilers of ordinary type, should be fitted with a surface condenser on Perkins's principle, in order to test its applicability to that description of boiler.

"12. In all these trials the system, as pursued by Mr. Perkins in his land engine, which the Committee have examined, should be most closely adhered to; and his metal applied wherever requisite to avoid the necessity of internal lubrication, which it is alleged is not required when that metal is used.

"13. In consideration of the circumstances in which Mr. Perkins is placed with regard to the Yorkshire Engine Company (Limited); and as the Committee are not aware that this Company have hitherto supplied marine engines or boilers for Her Majesty's Service or the Merchant Service; and looking to the general circumstances attending the application of a new invention to engines of a larger size, and of different construction to those which have hitherto been tried under Perkins's system, the Committee would suggest the propriety of constructing these engines and boilers in one of Her Majesty's Dockyards under the superintendence of Mr. Perkins, if their Lordships should under the above-named circumstances deem it desirable so to do.

"14. In the event of their Lordships arriving at this decision, the Committee would suggest that the drawings for the engines, boilers, and condensers should be prepared by Mr. Perkins, and submitted to the Admiralty for approval; and that for this purpose Mr. Perkins might have the assistance of a draughtsman, but he should take the whole responsibility of the result, and superintend the construction in the ordinary manner as an engineer.

"15. It is the intention of the Committee to keep the question of the use of soft fresh water in view; and they expect to obtain still further evidence during their visits to the different seaports and manufacturing towns of the country; yet they have considered it advisable that they should at this time state their views upon this question, so far as they are enabled to do so; reserving their detailed and more matured opinions on the question of the use of soft fresh water for marine boilers generally, until their final report.

"I am, &c.
(Signed) EDWIN WATSON,
"The Secretary to the Admiralty." "Secretary to the Committee.

APPENDIX B.

Copies of Certificates of the working of Perkins's Patent Metal for Piston Packing Rings of Steam Engines both at Sea and on Land.

"Loftus Perkins, Esq.

"DEAR SIR,

"Callao, 14th December, 1876.

"In reply to your enquiry I have much pleasure in informing you that the Perkins's Patent Metal Packing Rings, which I obtained from you for the high pressure pistons of our steamers 'Atacama' and 'Coquimbo,' have given me every satisfaction.

"The cylinders which formerly were rough and slightly grooved were, in the course of two or three voyages, say, after running 10,000 miles, brought up to a beautiful smooth surface by the action of the Patent Metal Rings, and have since kept in capital working order, giving no trouble whatever. To obtain the full benefit of your Patent Metal Piston Packing Rings they should be fitted to new engines, as I do not consider they get a fair trial by putting them into cylinders already cut up and worn out of truth by cast-iron rings.

"The principal merits of your Patent Metal I consider to be: the Packing Ring does not wear the cylinder, after having once been brought up to a smooth working surface. The wear on the rings is also very slight, friction is reduced to a minimum. One third of the lubrication necessary for cast-iron rings is sufficient for the patent metal ones.

VOL. XXI.

3 F

" Note.—The rings should be very slightly sprung after they and the cylinders have come to a proper bearing surface.

" I am, dear Sir, yours truly,

(Signed) " ARCHD. D. BRYCE,

" Supt. Engineer Pacific Steam Navigation Co."

" Church Wharf, Chiswick, London, W.,

" February 14th, 1877.

" Messrs. Perkins & Co.

" GENTLEMEN.—We have your enquiry regarding our experience of 'Perkins's Metal,' and in reply we beg to state that we are only using it for piston rings and not for slide valves. This was explained to Mr. Perkins.

" It is a splendid material for piston rings, as there is no chance of the cylinders being scored when it is in use.

" We supplied it for the piston rings of the torpedo vessels we lately delivered to the French Government, and found we could run the two hours' trial easily at the rate of about 480 revolutions per minute, and without using any oil or grease in the cylinders.

" We are, Gentlemen, yours faithfully,

(Signed) " JOHN J. THORNCROFT & Co."

" The Dorking Grey Stone Lime Company, Betchworth, Surrey,

" Messrs. Perkins & Co.

" 15th February, 1877.

" DEAR SIRS,—In reply to yours of the 13th, I beg to say that we have now used the Perkins's Patent Metal Piston Rings for our engines three years next June, and I can only say they are, in my opinion, simply perfect; they require no grease of any kind and work the cylinders to a polished face, need no looking to until worn out; a set will last about 100 days at 400lbs. steam pressure. Of course at a lower pressure they will wear very much longer, but the above is what we work at usually.

" I am, yours truly,

(Signed) " WM. FINLAY,

" Secretary and Manager."

" Messrs. Perkins & Co.

" Badsley Works, Birmingham, February 20th, 1877.

" DEAR SIRS,

" Our experience of Perkins's Patent Piston Metal for Packing Rings of Pistons is greatly in its favour.

" We should not think of using iron rings, as they will not last nearly so long, particularly in our engine, which is without lubrication. The Patent Metal is dearer in the first instance, but that is of little consequence, as it can be remelted.

" Yours truly,

(Signed) " PEYTON & PEYTON."

The CHAIRMAN: Gentlemen.—It is now my pleasing duty to ask for the fullest discussion which can be given to so important a subject. I am quite sure that if we appreciate the fact that the statement of this paper is very much as if you should be told that a domestic servant, the one most frequently employed, was prepared to work, only consuming half the former food, with no blowing up, and without any trouble to yourselves, I think you would be delighted with such a statement, and this is not an exaggerated analogy of the assertion Mr. Perkins has made to-night about steam-boilers. If he is able to meet the discussion, which I have no doubt will take place, I have no hesitation in saying he will have added 50 per cent. to the power of England whether afloat or on shore.

Lord ALFRED CHURCHILL: I do not quite understand the construction of the surface condensers. Is there a second pipe? If there is one pipe within another, in what direction do the others come? I can hardly see the direction, whether the water flows through the centre and outside back again, or the reverse way.

Mr. L. OLBRICH, C.E.: When we discuss paper of this description it is no doubt difficult to realize that we must not judge what is being put before us by the ordinary standard of boilers that we are in the habit of using. If we judge it by the

ordinary standard, I should say that we should come to grief. I mean by this that there are so many points that we are in the habit of seeing which we do not see in this instance. With ordinary engines it has been long considered that when we exceed a pressure of about 80 lbs., we exceed the pressure which will give us fairly economical results with the most modern compound engine. When we exceed that pressure there are many difficulties we have to contend with which seem to have been overcome by the system which is now put before us. When we go into greater pressures we must increase the stuffing boxes, and thereby increase the friction of all the moving parts, and we must increase the diameter and the length of the glands, thus also increasing the friction. But Mr. Perkins has shown us that many of these points that we should be afraid to encounter with the present modern compound engine and the prevalent pressure, he has overcome by designing special remedies in special cases. He has for instance laid before us a piston that seems to me capable of coping with the great difficulty of arresting steam of that very high pressure, and consequently also of very great velocity and very great power of escape. It appears that he has overcome it by using a special metal, and also by having a number of very thin rings for his piston, so that even the great velocity of the high pressure steam is not quick enough to pass the different rings so as to escape on the other side of the piston, and thereby be wasted. Again, he has found out by experiment a special metal for piston rings, a metal which need not be lubricated, and lubrication is one of the great evils in the present compound engines, because if you lubricate too much you meet with a difficulty that you pump into your boilers, (according to my notion) what destroys our present boilers. When you pump lubricating material, that is generally vegetable material, into the boilers, the combination of the condensed water and vegetable material causes an immediate priming of the boilers that shows that it does harm in the first instance; and secondly, by a chemical combination that I am not able to explain, but I believe that is one of the principal reasons why the present boilers are destroyed,—a combination of the vegetable matter pumped into the boilers along with the feed-water. The next point I come to is the boiler. There is a kind of boiler used for ordinary purposes called a cross-tube boiler. In these boilers, with perfectly horizontal tubes, we find that they are burnt on the top. On account of their horizontal position, as the steam accumulates at the top of the tube, and as there is no water in contact with the metal, it burns and ultimately gives way. In such boilers this evil is remedied by making the tubes slanting, thereby allowing the steam to escape from the cross-tube, and to find its way into the steam space of the boiler. Now it appears that Mr. Perkins has not the slightest hesitation in exposing his entirely level and horizontal tubes to the action of the fire. We shall be obliged to him if he will explain how proper circulation of the water can take place in these tubes. Mr. Perkins has pointed out as of great importance (and there can be no doubt it is of the greatest importance), that a fleet all fitted with this kind of boilers, from the smallest yacht to the largest ironclad, can exchange the tubes necessary for the boiler. In the Navy, at the present moment, there are any number of variations, and there is perfect impossibility of exchanging spare gear from one engine or boiler to another. By using this boiler, an ironclad that would have come to grief could collect spare gear from all the other ships, and thereby, in a short space of time, be in an efficient state to fight again, whereas, under ordinary circumstances, she would have to go to the nearest harbour, and perhaps lay there for months before she could get her boilers replaced. One point I should have thought somewhat against the system was the water-reservoir, because to have a large store of water in the ship would of course to some extent counteract the diminution in the amount of coal that would be required; but Mr. Perkins says, it is all but unnecessary to keep a large store, because leakage is practically impossible in his boilers and attendant machinery. There is one question more I should like to ask. Mr. Perkins mentioned that in an engine which indicated 50 horse-power, the steam-pipe was not more than one-eighth of an inch in diameter. That seems almost incredible, and I can only say that if this is correct without any material wire drawing, it is something new in engineering. But I should like to ask the author of the paper, what is the difference between the pressure in the boiler before the steam enters the small steam-pipe of one-eighth of an inch, and the pressure when it arrives

790 ON RECENT ECONOMIES IN USE OF FUEL FOR WORKING

in the cylinder, because to ordinary minds it would be reduced very considerably by wire drawing.

Mr. DONALDSON: Firm of Thornycroft and Co. It affords me very great pleasure to corroborate the statement of Mr. Perkins with regard to the use of his patent Anti-friction Metal.

It fell to my lot last year to superintend the trials of two torpedo vessels which my firm built for the French Government, and which we had contracted should run at sea for two hours at the guaranteed speed of 18 knots per hour.

In the preliminary runs we had a great deal of difficulty from priming, finding it impossible sometimes to run even for one hour without trouble in that way.

At last, believing that our difficulties arose from the use of oil in the cylinders as a lubricant, which, accumulating in the condenser and pipes, was pumped thence into the boiler, I resolved, as the pistons were fitted with rings of Perkins's metal, to abandon the use of oil altogether, and to run the engines dry; so I had the condenser and boiler cleaned out with caustic potash, and then had perfectly pure water pumped in. The result was that we found we could run the boat continuously for the two hours without the slightest fear of priming.

I may add, that in the "Lightning," a vessel we have just completed for the English Navy, we have not used any oil in the cylinders as yet, the only grease that has to my knowledge found its way to the cylinders, having come from the indicator pistons where a small piece of tallow had been put during the preliminary runs. In this vessel we have had no priming, and no symptom of priming.

The CHAIRMAN: Will you name the number of revolutions?

Mr. DONALDSON: In the French boats about 430 per minute for two hours; during which time we ran a distance of 36 knots, and in the "Lightning" from 350 to 375 revolutions per minute.

Lord A. CHURCHILL: Are the boilers constructed on this system?

Mr. DONALDSON: No, they are of the ordinary locomotive type. I may remark with regard to the deterioration of boilers that when I was in Paris lately, M. Sabattier, the Chief Constructor of the French Navy, showed me a dark-brown mass, which he said had been taken from one of the boilers under his charge, and which he described as oleate of iron. He considered that the deterioration of the boilers of surface-condensing engines was due in a great measure to the oil being decomposed, and oleate of iron being formed by the action of the oleic action on the iron of the boiler. In the French Navy they were preventing this to a great extent by putting lime in the water, which, combining with the oleic acid, formed oleate of lime, a specimen of which, a white granular mass, he also showed me. If Mr. Perkins, by the use of his patent metal, has got over the necessity of using oil in the cylinders of surface-condensing engines, and I believe he has, he will in my opinion have added greatly to the life of modern marine boilers.

Lord A. CHURCHILL: What was the appearance of your cylinders after running at that high speed of 430 revolutions?

Mr. DONALDSON: After the trials, the cylinders were opened out, and examined most carefully by a Commission of Naval Officers and Engineers, appointed by the Minister of Marine, to take over the vessels, and they were found in perfect condition,—the insides of the cylinders being quite bright, and the valve faces in the same condition. The slide valves were made of gun-metal, with plugs of white metal over the surface, and I think the valves were greatly assisted in their work by minute particles of the Perkins' metal, which came over from the piston rings, and acted as a lubricant.

Mr. PARKER: Having had a little experience at sea with water tube boilers, I would like to ask Mr. Perkins a few questions. First, how he ensures perfect circulation in the lower tubes of his boilers. Secondly, in what respects these boilers differ from those fitted in the steamers "Fairy Dell," "Marc Antonia," "Montana," and "Dakota." This principle of a water tube boiler working at a high pressure is not at all a new one. The boilers fitted in the vessels named were in my opinion very similar to this, they were all tested from 150 to 300 lbs. per square inch, but at a steam pressure of 60, 70, and 100 lbs. they gave way. The "Fairy Dell," made two or three voyages across the North Sea. The circulation in the lower tubes was found to be defective and the tubes cracked; on the third voyage

the boiler gave out at sea; the vessel was rendered helpless; she fell off in the trough of the sea and foundered with a number of hands. The next boiler of this description for marine purposes was fitted in the "Marc Antonia." That vessel made a voyage to the Cape of Good Hope. She was expected to make that voyage in about thirty days, but owing to the boiler giving out at these lower tubes she took three months to make the passage, and it was with very great difficulty they got her home. The boiler was altered to improve the circulation and she made two voyages to the Mediterranean. On her second voyage while crossing the Bay of Biscay the lower tubes completely gave out, the engines stopped, the vessel fell in the trough of the sea and sank—fortunately all hands were saved by a passing steamer. The "Montana" was a much larger vessel, almost 5,000 tons, fitted with boilers at an enormous cost, which, in my opinion, were very similar to these. There were a number of stacks of tubes connected at each end as shewn in that diagram. The tubes were 14 inches in diameter and 15 feet long, and they had a little incline to induce circulation. The cost of these boilers was over 35,000*l.* The "Montana" left the Tyne, and before she got off the Isle of Wight, six of these boilers gave out owing to the imperfect circulation in the lower tubes, the vessel was thirty-six hours helpless in the Channel. The engineers worked the whole of that time, disconnected the bad tubes, and they managed eventually to get the vessel into Portsmouth. After patching up the boilers she went on to Liverpool, but it was deemed advisable to make a long trip into the Atlantic to test the boilers before making a voyage. She left with the intention of steaming six days. On her second day out, two tubes in two different boilers again cracked and rendered the boilers useless. The owners, therefore, determined to take them out. The vessel was taken back to Liverpool, and new boilers were made both for that ship and the sister ship, the "Dakota," at an immense cost. Thorough trials on land had previously been made of these boilers. A section of the "Montana's" boiler, 100 horse-power, was fitted up in the yard at Jarrow, and steamed for six weeks night and day. It gave the most perfect satisfaction under these circumstances, but when it was subjected to wear and tear at sea, it gave out.

Mr. LOFTUS PERKINS: Was that a section of a boiler, or a whole boiler?

Mr. PARKER: A section of a boiler. I would, therefore, like to ask Mr. Perkins how long this boiler of his has been steaming day after day without stopping the engines, and how many successive days he has timed it at sea. Another water tubular boiler has been fitted to an ocean-going steamer, but instead of the tubes being horizontal they were vertical, so that the steam as generated had free escape to the steam-space. That boiler ran about eighteen months, but owing to a mistake made in connecting the two sections one section became dry while the other filled with water. As a consequence one of the lower chambers exploded and two men were killed. That was altogether an engineering mistake, and the boiler was therefore taken out. But the owner, I understand, to this day regrets having done so. I believe there are other boilers of that description working satisfactorily now. Having conducted these trials myself, my practical experience shews the great necessity there is of ensuring perfect circulation in such boilers as this, and the great difficulty of doing so, I therefore should like Mr. Perkins to answer the questions I have asked.

Mr. THORNYCROFT: It appears to me the last speaker has been comparing this boiler with that of the "Montana" and other vessels in a way which is not fair to the proposition Mr. Perkins has put before us. In the "Montana" a water-tube boiler somewhat like this was used, but the pressure of steam used was very small.

Mr. PARKER: 100*lbs.*

Mr. THORNYCROFT: That I beg to say for this particular kind of boiler is small. What Mr. Perkins proposes to do in his boiler is to work with steam very dense indeed and the amount of steam that is produced by a certain volume of water is very small compared with steam at ordinary pressures, and would almost suggest that Mr. Perkins should use higher pressures than the pressure he is now proposing, because of the very advantage which is given by this system for using steam of very small volume. In the "Montana" and some vessels that have given trouble, the steam passages in the boiler were so small that the only thing the boiler ought to have done was to have opened out. There was no proper egress made for the steam,

and the water was blown out of one compartment into another, and the boiler was burnt. With regard to Mr. Perkins's engine he has, I believe, displayed very great ingenuity in the manner in which he has got over the difficulty of using this very high steam. But there is one question, that is at what rate of evaporation this boiler would work satisfactorily, because from what I have heard and seen of this boiler I believe, up to a certain rate, it is reliable, but I also believe there is a limit to the amount of steam that may be produced in one of these generators, and if we had the information as to how much steam may be safely generated in one of these, then we should be able to compare this boiler with those in ordinary use? As to the durability of the boilers, the evidence of the boiler Committee seems conclusive that the structure is very durable. There is one remark I should like to make with regard to Mr. Perkins's metal, that is that it does not seem capable of cutting a cast-iron cylinder.

Mr. DONALDSON: My idea of the action of Perkins's metal is that it crumbles, and that it is the very fine dust resulting from this crumbling that keeps the valves. The rings were beautifully bright.

Mr. J. F. SPENCER: I have had the opportunity of going up the river two or three times in Mr. Perkins's yacht, and, as a marine engineer, was at first very much prejudiced against his system; from further observation it seemed to me, however, to be the nearest approach to perfection for using high-pressure steam. One great difficulty in the introduction of high-pressure steam has not been so much in the boiler itself but in preventing the introduction of impurities which would destroy it, and this Mr. Perkins has apparently overcome by using perfectly pure and not even distilled sea water. Mr. Perkins has found that even if the feed water is distilled from sea water an injurious action takes place which would destroy his boiler, and therefore it comes to the point of being obliged in long sea voyages to distil from fresh water, and that is only feasible in such cases by preserving almost every drop of water put into the boiler and passing it back again, and hence the apparent complication of his machinery which requires so much apparatus to enable him to avoid any waste, so that a few gallons of water is sufficient to make up all the waste required in a week. That seems to me a point of very great value. *It is quite novel, and I do not think it has been put into a practical shape by any one except Mr. Perkins.* If we secure the durability of the boilers all doubt about the advantage of using very high pressure passes away. With reference to the engines, I think it will be seen at once that this is a probable solution of the high-pressure difficulty of high temperatures. I say nothing about the arrangement of the details, but the plan of introducing steam of high temperature where there is no rod which passes through a stuffing-box seems to me the only one that could be ultimately successful, because then you have only the one difficulty to deal with, and that is to obtain a piston which is self-lubricating, and this appears to be overcome by Mr. Perkins's piston metal. So far, we have not been able to find any metallic packing for the stuffing-boxes of the piston-rods of engines which will stand wear and tear and high temperatures. With reference to the boiler, the remarks made by Mr. Parker do not necessarily apply injuriously in the case of Mr. Perkins's boiler. The one in the "Emily" has been working a long time, and going to and below Gravesend the water was perfectly steady. If a boiler will work for years without showing any deterioration, and the tubes are as durable as those exhibited, it evidently shows that the design and system are good. Mr. Perkins has not in his plan shewn where the feed water is introduced, which I presume is at the bottom, and therefore as fast as the steam has passed away, so the water is introduced to the lower tubes.

Mr. PERKINS: That is so.

Mr. SPENCER: The bottom tubes could not be entirely exhausted until all the water had been evaporated and passed away. If a pipe is burnt or destroyed, it is so small in size, its renewal is a very different thing from the case of the "Montana," where you had to deal with very powerful tubes of very large diameter. I think, therefore, the tone and tendency of the remarks made by Mr. Parker are unfairly inimical to the system under discussion. In the successful introduction of improvements, so much depends on perfection of detail, and whatever success Mr. Perkins has had, is due to this great attention to the numerous details connected with the improvement. As a practical engineer, very much prejudiced against this system,

my careful examination of its working the last few months has so far convinced me it is a *practical* arrangement, that I feel satisfied it is only a question of time (whether in Mr. Perkins's exact form, I do not say) for this system of engines and boilers to be adopted in general practice; and I simply give this as an opinion from what I have seen of Mr. Perkins's inventions.

Mr. HYDE: Some twenty years ago, being a shipbuilder professionally, I constructed a steam-ship, in which I endeavoured to introduce the most modern and economical principles for driving her. Naturally, the question which Mr. Perkins has been working at presented itself to me, as it has, no doubt, to those who are interested in this matter. I thought then, that the purer the water the greater the economy would be; and when my ship went to sea, I gave express orders to my engineer that, under no circumstances whatever, should he allow any steam to escape from his boiler. His working pressure was 20 lbs., that was rather a good pressure for so long a time ago as twenty years, and his valves were balanced at 22. The ship voyaged from Liverpool to London, and back, and the instructions were to carry the same water during the whole round, and not to put any fresh water in the boiler—the idea being that the pure water having no impurities, such as lime and salt, we should make our boiler last very much longer. After the ship had been running about six months, I went to my engineer, and said, "Take the man-holes off "your boiler, let me go and have a look at them." I went into the boilers, and, to my great amusement, I saw them pitted all over with extraordinary holes, into which I could place the ball of my thumb. Boilers cost large sums of money, and I had to keep these boilers going for a year. Naturally, I felt very much alarmed about it, and accused my engineer of pumping, for his own convenience, some of the various nostrums that are sold to keep boilers clean. He said he had not. The thing was perfectly unaccountable to me, because the metal of which the boilers were made was the purest I could get, and my disgust was very great. This experience may throw a little light upon the question before the Institution, therefore I mention it to you. I saw in a moment that the water I had been using in my boilers was too pure, and had some chemical affinity for the iron which I could not explain. That really is the case with all marine boilers that use pure water. I have known hundreds of boilers in which this particular kind of pitting has taken place, and it has been argued by many that it is a galvanic action between the copper tubes and pipes, and so forth, which exist in all steam-engines and boilers. I think it is the pure water thrown back from the surface condenser, backwards and forwards, until it becomes so pure, it takes out some of that particular material of which the iron is constructed, and hence the destruction. I gave my engineer instructions to change his water every two or three hours, blow a foot out of the boiler every watch, and pump it up again, and that saved my boilers, which lasted ten years. If I had not given him instructions to change his water, the holes would have got bigger in the course of a month or two, and the boiler would have been destroyed. In all cases where boilers have to be repaired, I see that the iron is gnawed and eaten away, pitted—what they call in common language, having the small-pox all over—holes in them, scabs all about them; and the only explanation which can be given is this, that the pure water pumped from the ordinary surface condenser has got some affinity for the material of which the iron is made, hence the destruction. I have given this intimation to engineers and ship-owners, and they have found that by blowing out a little water, and pumping in fresh water, that difficulty does not take place, and the boiler lasts very much longer. Of course, the water returned by the surface condenser has not any lime in it, or any salt, and the consequence is the boilers last very much longer. As regards the pressure, there is no doubt about the pressure being the vast economy in the matter of a steam-engine; and the question is, what is the safest pressure you can work at? It might be illustrated in this way: If you have an engine that you use, say at 10 lbs. to the inch, and all your elements are strong enough, the engine delivering 100 horse-power, you double the power immediately by using 20 lbs. to the inch. If your material is strong enough, you can double your power again by using 40 lbs. to the inch, and so you can double it again by using 80 lbs., and so you go on till you reach a point when you cannot add to the pressure; therefore, every man who knows anything about steam-engines will see at a glance the whole economy

of the thing is in the boiler. Often neglected by those who have steam-engines, the boiler is the thing of all others they unfortunately pinch. In most steam-ships the boilers should be 50 or 70 per cent. bigger than you really require, and so you get larger economy. As a rule, they say "How small can you make the boiler?" but it should be "How large can you make it?" and then you get large economy. Mr. Perkins has three pistons in his engines. Supposing you take the area of all three cylinders, measure them out accurately, and make one cylinder equivalent to the combined area of the whole three, would not an engine so constructed, into which a fixed quantity of steam can be admitted with one simple piston having the area of the three combined, be mechanically as economical as the combination there? You would have less complexity and much less friction, and by wire-drawing very high pressure steam, I hold you would obtain the same result as with a number of cylinders.

The CHAIRMAN : This is a subject to which I have devoted a great deal of attention, convinced as I have always been that in the boiler is the heart of the ship. We have abandoned to a very large extent all reference to sail power in our men-of-war, and if the boilers are not in perfect condition, it is quite clear these ships are for all practical purposes utterly inefficient, and may even endanger each other. The boilers hitherto have only lasted, in exceptional circumstances, a full commission—three years; at the end of that time it has generally been necessary to cut the ship to pieces, to put in new boilers. This could not be done at all, unless in a port where appliances for dealing with ironclads existed; therefore you will see at once what is the gravity of the question which this system professes to attack. The facility of construction is of considerable importance. When boilers are wanted on this system, I conceive any number of workmen, and consequently any speed required, may be employed in the construction; whereas, in an ordinary boiler, only a certain number of workmen engaged in riveting up can be employed. These boilers can be made in sections, and put together. That is an important point as regards the construction of boilers in a hurry. Then, also, the point to which the author has adverted, of being able to bring the boilers low down in the ship means immunity from damage by projectiles; that is also an important point to consider. The question I had the honour of bringing before this Institution some short time since, of economy of fuel, is here largely considered. These boilers are, in fact, vapour generators. In the ordinary sense of the term, as now understood, a boiler is a water-box, into which large quantities of water are pumped, and in which large quantities of water are kept to be slowly evaporated, with all the chances against the steam getting freely to the surface, as it ought to do. In these boilers, on the contrary, a very small quantity of water is used; it can flash into steam at once, and the circulation is practically perfect, because, instead of being water circulation, it is vapour circulation. To all intents and purposes, these boilers can safely be so used, because no tube can get hotter than the temperature of the steam inside it. That is not the case in water boilers, where you can drive the water in the spheroidal state from the plates; you can have a layer of steam existing between the two, but that does not prevent the boiler-plates from getting red hot. Here this is not the case. The enormous additional strength, owing to the employment of small tubes of three inches diameter for the whole structure is also a very important fact. As to the boilers of the "Montana," and other ships referred to, I had the pleasure last year—I can scarcely say pleasure—of seeing the diagrams, and hearing a long explanation of those boilers which have failed at sea; they were emphatically water-tube boilers, containing almost as much water as the old boilers, and they failed, as they ought to have failed. As has been remarked, they ought to have done nothing less than what they did—that is, disappoint their constructors—and I took occasion to regret that a subject of such importance should have fallen into the hands of persons utterly ignorant of the first principles of making tubulous high-pressure boilers. The interchangeability of the parts has a much greater importance even than that which the author of the paper has claimed. It means this, that no matter what the size of the ship in your fleet, she is always capable of either giving or receiving parts of boilers. If, in a fleet, considerable damage has been done to the most efficient and most valuable vessel of that fleet, her boilers can be very shortly repaired in the squadron while at sea. That, I need scarcely say, is not the case at all at the present moment. There is

also another question, the immunity from explosion. Those boilers may burst or be destroyed by shot, but they do not burst in the ordinary sense of the term. What issues into the air, as I shall hope to hear at this Institution from Professor Barff shortly, is oxygen and hydrogen gas, in juxtaposition but not in combination; and, under those circumstances, those gases so heated are not immediately capable of scalding or destroying the human frame. This is the great difference between very high-pressure steam like this, in which the water is really decomposed,¹ and low-pressure steam, which is water-vapour, to all intents and purposes. The reserve power has been adverted to, and is another most important point for the Institution to consider. There is one objection, and it is that question, how far we can always manage to supply at sea distilled fresh water to these boilers. I do not understand that any attempt has been made in the paper to give us proportional quantities of water per horse-power; and Mr. Perkins would do well if he gave us some idea per horse-power, what size of boilers per horse-power, what quantity of water might be necessary, weights, and everything else, so that we may judge by comparison with existing results how far it is desirable to introduce the system. It has been objected to it by a very high authority that it involves increased cost of boilers, increased complexity of engines, and increased difficulty in putting on board originally. Well, the difficulty of putting on board I do not believe exists at all. The increased cost is met by this statement, that if your boiler does its duty, in all cases and under all circumstances, it is cheap at any money that you can give for it; and that a boiler which lasts thirteen years (and that is the existence to which it has already attained, not by any means the measure of its possible existence), is certainly far cheaper than a boiler which cannot long support the pressure for which it was designed, and which only lasts three years, no matter how little its first cost may be. The objection to complexity of the engine is best met by the question, would anybody be disposed to go back to low pressure engines, with their waste of fuel, because they are simple? It is quite clear that, as the useful life of our steam-ships depends on their power to carry fuel for full speed, if you can double this power, and increase it from three days to six, you will have done a great deal. If you can still further increase that, as the system is developed, as I have no reason to doubt you can do by a change in the character of the fuel, we may look to a fair amount of work being done by steam at sea irrespective of sails. At present, I am sorry to say, recent circumstances have shown us a ship may be deprived of all power of locomotion of any value, and may gradually be driven so close to a lee shore as to be in the utmost danger, for want of efficient machinery, boilers, or fuel for the boilers. She has no sail power, and can do nothing in that way; therefore it is of the utmost importance that this subject should be thoroughly investigated; and it would be fair to inquire why it is that, with boilers and engines of this class at work in the United Kingdom during thirteen years, we have not seen as yet any attempt to develop it further. I hear that a contract was entered into in 1873 to supply these engines and boilers, but that, by that strange perversity which gives no credit whatever to an inventor for knowing his own subject best, and prefers to give it for development to some one who knows nothing about it, it has come to pass that we are still without any engines and boilers on the Perkins system.

This certainly ought not to be so, and I hope it will not continue to be so. I cannot leave out of the question that which has been said about the internal corrosion of these boilers. It is perfectly true that, whenever you deal with pure, distilled, fresh water, you have got the most powerful solvent known to chemists. It is capable of attacking all metals, and dissolving them, in accordance with certain well-understood galvanic laws. But if you choose to proportion the metals put together in such a way as that the metal attacked will be the one you do not wish to preserve, and the metal which you wish to preserve, is in a proper relation in that galvanic couple, there is no difficulty with any chemical solution, whether distilled water or any other, in preserving one metal and allowing the other to decay. There is a still better way of doing this, which will shortly be brought to your notice more at large by Professor Barff, which is the internal peroxidation of the boilers in the form of magnetic oxide, which is a perfect preserva-

¹ Grove was the first to state that "Heat alone can decompose water."

tive against even acid solutions. It is known to be imperishable, for we have examples of it in the magnetic iron sands of various sea-beaches throughout the world, where it has lasted, in New Zealand, for instance, since that portion of the world was created. There is no danger of its proving unreliable. The point spoken of in the paper as not yet solved, I have inquired into. I find that, in distillation of salt water, chlorine leaves the sodium and distils over with the steam, and that the rapid destruction of the boilers under these conditions is probably due to the presence of the chlorine, which rapidly changes into hydrochloric acid, and attacks the iron at that temperature and under those conditions. This can, perhaps, be met either by the protection given by Professor Barff's system or by the protection given by a coating of lime, such as is deposited in all boilers in which lime in some form is an inevitable constituent of the water pumped in; or, again, and far better, by the absorption of the chlorine after distillation, by being passed through lime. The lime absorbs the chlorine and makes chloride of lime, and you get the distilled water it may be, in some cases, if disturbed, with a small quantity of lime in it, which could be eliminated by further distillation, and, at any rate, is not very injurious to the interior of your tubes. Therefore, there is no real difficulty not capable of being attacked by competent chemical knowledge which presents itself at present on this question. The feature of the economy of fuel and the coating of the whole exterior of boiler by a casing almost impermeable to heat is a matter also of the utmost importance. Our stoke-holes to-day are commonly at 120° ; it is not at all uncommon even in temperate climates to find the stoke-hole of a large steamer at that degree of temperature. Apart from the inconvenience which this produces to those who have to work the engines and boilers, I will ask you to consider the enormous loss of heat that represents, and how in this direction you are throwing your fuel away at the same time that you are resorting to all sorts of other contrivances to economise it. This boiler can be so surrounded as no other boiler can. In it there is a proper ignition chamber, which no other boiler possesses, and it therefore can economise fuel to an extent we have not hitherto seen. But the chief economy in this, as in all other compound engines, is not in the engine, it is in the boiler pressure. Mr. Perkins in his paper adverted to the well-known fact that it takes no more fuel to keep steam at 1,000 lbs. of pressure on the inch than at 1 lb. The pressure is entirely an outside condition. It takes more to make, but it does not take more to keep it at a greater pressure and temperature when once made. This is the source of our principal future economy, and it is one which must never be lost sight of. It is even quite true that the compound engines can be advantageously replaced sometimes at moderate temperatures of steam by single cylinder engines with an economy of parts, and with certain other economies, even in the use of the steam itself, but this can never be done where the steam has an initial temperature of some 300, 400, 500 degrees. Here we should utterly fail to condense if we at once passed the steam into the ordinary condenser; it would take a condenser half as big as a ship to do any real good, therefore we do use, and with good results, such compound engines as those you see there. It is no answer to say the complexity of parts makes them unadvisable; the point we have to look at is whether they do better work with less fuel. This paper contains a promise of an advance such as can scarcely be overrated, and which ought to receive the most close investigation. It is emphatically one which should not be relegated to the background of an unimportant experiment made by private parties, but is deserving of national attention, for it is likely to prove of national importance.

Mr. PERKINS, in reply said: Lord Alfred Churchill spoke about the tubes in the condenser, and inquired if there was an internal tube. The condenser tubes are only fixed in a tube plate at one end, thus leaving them free to expand and contract without injury to the joints. There is an internal tube that goes to the top of the external tube to conduct the water up to the end.

Mr. Olrich mentioned about the circulation of water in this boiler. The boiler described in my paper, is not built for the purpose of circulating water. These boilers, make steam by foaming; the water does not circulate as it does in a hot water circulating apparatus, the water foams, and the whole of that boiler is partially full of steam and partially full of water; if you draw from the bottom tube of the boiler, you will find steam there just the same as out of the middle tube. We find this in

working these boilers, that if we place the water gauge in a low boiler up to the top tube we can get dry steam ; if we place the water-gauge half-way down in a high boiler, we find very often we get wet steam, showing that time must be allowed for the separation of the water from the steam. These boilers work more like an ammonia-separator than like steam boilers as ordinarily made. With regard to the tubes burning, they never burn under any circumstances whatever, as long as the water is kept at a proper level in the gauge. There has never been any sign in all the boilers we have constructed of one tube having been hot, except when the feed has been neglected. Mr. Olrich also spoke about the small tube that supplied that engine (meaning the winding engine with the one-eighth inch diameter bore steam-pipe). Mr. Rennie asked me to place a gauge on each side of the pipe, and we did so ; there was 150 lbs. pressure on one side, and 270 lbs. on the other ; the engine when cutting off had twenty-four expansions ; there was 20 lbs. initial in the high-pressure cylinder.

Mr. Parker spoke about the "Montana." The "Montana's" boiler was wrongly constructed, inasmuch as there was no proper connection for levelling the water in the boiler ; the consequence was, the water was flying up and down in the different sections, leaving some sections dry, which no doubt became red hot. That is the case in all these sorts of boilers in which they have no proper connection for levelling the water. In these fire-box boilers, which I have described in my paper, nothing of that sort ever happens, the connections for levelling the water being entirely different in principle. The boiler fixed in the "Montana" and "Dakota" was an exaggerated copy of one of my boilers, in which was left out the most important tube for levelling the water. If they had increased the outlets to the steam pipes very likely it would have worked all right as far as not burning the boiler. My boilers have been at work many years, and we have never had any trouble with them. I have had them in my boat, which is very crank, and if you were to turn the boat upside down quickly, and right her again, there would be no fear of burning the boiler.

Mr. Hyde spoke of the disadvantage of pure water from sea water. I have tried that same experiment which he described. With regard to working distilled water in boilers, in which the distilled water was derived from sea water, I found it had just the same effect,—it ate the boiler away, pitted it, and left holes full of a black substance, the composition of which is uncertain. The cure I found for this decay (and it only happens when distilled sea water is used) is to supply the boiler with fresh water, or distilled fresh water, then it never happens. If the water is pure it has no effect upon iron. There are a great many points that must be considered when you try experiments with water. Air has a great deal to do with it. With regard to getting pure water from sea water, it is an impossibility to distil it so as to get it pure, therefore the water in Mr. Hyde's boiler (although very likely he could drink it) may have been very impure ; distilled sea water will eat away the boiler, but distilled fresh water has no effect on the iron, whether in my boilers or in boilers of the ordinary description. Mr. Hyde also spoke about the working of steam in one cylinder. If he were to make an engine to work steam at 250 lbs. or 500 lbs. pressure, and expand the steam in one cylinder thirty-two times, it would theoretically be quite as effective as the engine described in my paper ; but he would find he must have his crank shaft about six or eight times the size, and a piston-rod in proportion ; the consequence would be instead of weighing 27 tons it would weigh about 500.

Mr. Thornycroft asked a question about the evaporation of the boiler. We tried a great many experiments with road engines, and when we were on the road we found it was very difficult to get up some hills. The engine had an air surface condenser, and the fire-grate was very limited—only about a square foot, and was intended to work with natural draught, but we found we could not get up the hills. The consequence was we turned the exhaust pipe into the chimney, and with a square foot of fire-grate we burnt as much as 80 lbs. of coke per hour. No doubt a very large quantity of water was evaporated, quite equivalent to what a locomotive boiler does. We worked it very hard ; the high-pressure cylinder worked at 500 lbs., and the low-pressure exhausted at 200 lbs., and with this blast in the chimney, it sent the sparks up fifty or sixty feet. I have therefore no doubt about the boilers standing any amount of fire you like to put on so long as it does not exceed 80 lbs. of fuel per

square foot of fire-grate per hour. The "Propontis" has been referred to, but the "Propontis" had the same fault as the "Montana" and "Dakota." She threw the water from one part of the boiler to the other. It was a composite boiler so managed that the water did not keep its proper level. This same action has taken place very often in factories, where there were a number of boilers improperly connected together, and it has always been the rule among engineers, when there have been a number of boilers connected together, to place a check valve on each, without which, if the pressure gets up in one more than in the other, it blows all the water out of one boiler into the other, and that is no doubt what has happened with a great many of these water-tube boilers; of course, if the water is not kept in the boiler, whether tubular or cylindrical, or flue, it has the same result, the boiler gets red hot; it begins to leak, or blow up.

There was a question about the weight of water per horse-power per hour; these diagrams show about 10·4 lbs. I fancy from 10 lbs. to 12 lbs. is a large allowance when steam is expended thirty-two times from 250 lbs. pressure, provided the cylinders are properly jacketed and the pistons are tight. With regard to the quantity of water to make good the waste, to show how little it is, I should not have the slightest objection to go from England to America in a steam-ship fitted with my boilers and engines, &c., carrying no reserve. I have had a stationary engine, indicating 250 horse-power, working for a fortnight, without any additional water being supplied to it, and, at the end of the fortnight, the owner had the engine stopped and the boiler cooled, because he became frightened, and thought there must be something wrong, as no fresh supply of water had been found necessary, and when cool, and the water-level in the boilers was examined, no perceptible difference in loss could be discovered. The allowance I should put on board ship, as a reserve to ensure a sufficiency to make good waste from all sources, would never exceed 4 per cent. in weight of the coal to be consumed on the voyage. I think that completes my answer to all the questions.

The CHAIRMAN: I am sure we shall all return our best thanks to Mr. Perkins for the extremely interesting paper he has brought before us.

APPENDIX C.

Comparison of the relative Consumption of Fuel on H.M.S. "Alexandra," with that obtainable by a Perkins' Engine of equal power.

<i>H.M.S. "Alexandra," R.N.</i>	<i>If Engined on the Perkins' System.</i>
<i>Present Engines, compound 60 lbs. steam pressure (See "Times," 3/3/77.)</i>	
I.H.P. 8497·9 at official trial 6 hours' steaming	I.H.P. 8497·9.
57 tons of coal consumed in 6 hours' steaming	22 tons 16 cwt. coal would be consumed in 16 hours' steaming.
2½ lbs of coal per I.H.P. per hour.....	1 lb. of coal per I.H.P. per hour.
228 tons of coal per day of 24 hours at full speed, equal to that obtained at the 6 hours' official trial	91·2 tons of coal per day of 24 hours at full speed, equal to that obtained at the 6 hours' official trial.
750 tons of coal total quantity carried ..	750 tons of coal total quantity carried.
3½ days' full steaming at power equal to that obtained at the 6 hours' official trial	8½ days' full steaming at power equal to that obtained at the 6 hours' official trial.
15 knots an hour mean speed at trial ..	15 knots an hour mean speed at trial.
1,170 knots total distance that the ship can run at full speed, consuming 750 tons of coal	2,970 knots total distance that the ship could run at full speed, consuming 750 tons of coal.

LECTURE.

Friday, April 13th, 1877.

COLONEL H. C. FLETCHER, C.M.G., Commanding 2nd Battalion
Scots Guards, in the Chair.

THE FURTHER DEVELOPMENT OF THE VOLUNTEER FORCE.

By GEORGE H. HOSTE, Esq., Admiralty, Civil Service Volunteers.

Introductory.

THE task that lies before a lecturer on this subject is one of considerable difficulty. To enter in detail into a statement of all that might be done to promote the further development of the Volunteer Force would be out of the question, even if a longer time were placed at his disposal than is the case. To embark in a mere sketchy essay would be trifling alike with the time of this Institution and the importance of the matter under consideration. A middle course, between undue depth, on the one hand, and shallowness on the other, is found in the method which I propose to adopt, viz., that of laying before the meeting a series of considerations, few in number, but sufficient, I believe, in substance, with the view of giving a well defined basis for the discussion which it is my especial object to evoke.

The Invasion of England.

The exhaustive manner in which Major-General Collinson handled the question of the possibilities of attack and defence of this country, has cleared the road of a whole host of objections which it would otherwise have been my duty to anticipate, such for instance as that which is frequently brought forward, to the effect that there is no chance of the invasion of these islands ever being attempted, and, which is even more common, that there is no chance of such an attempt being attended with success. On the probability of the occurrence of either contingency, I will not venture to offer an opinion, but will content myself with adopting General Collinson's demonstration, that there *is* a chance that both may, at no very distant date, be transformed into accomplished facts. For the latter and more disastrous catastrophe, that of a landing on British soil being definitively effected, we are to all appearances fairly well prepared.

Preparations for Defence.

Fortifications have arisen, or are destined to arise, to protect our naval arsenals and dockyards from land attack, while the science of harbour-defence is being rapidly matured. Surveys have been held in various districts, with the view of ascertaining the defensive capabilities of points especially liable to attack, while a notable scheme has been published in the Army List, and communicated to those whom it concerns, whereby—to adapt a term recognised in the German armies engaged in siege operations during the late war—alarm-posts are assigned to the various land forces at present enrolled in the dominions of Her Majesty at home.

The Volunteers.

With regard to the part which the Volunteers are destined to play in this scheme of insular defence, an assurance has recently been given by the Quartermaster-General (Major-General Lysons), to the effect that every member of the force will have work given him to do, although the distribution of the various battalions is not yet complete.

Before proceeding any further in this direction, it may be as well to glance at the present condition of that branch of the auxiliary contingent whose further development is advocated in this paper.

A Review of the Returns.

Every arm of the service is represented in the Volunteer force, although in very different degrees. In round numbers we find from the annual returns, dated the 1st November, 1876, that the enrolled strength at the close of the past "Volunteer" year was as follows:—

Light Horse	550
Artillery	35,000
Engineers	7,500
Mounted Rifles	150
Infantry	142,500

Giving a total of from 185,000 to 186,000.

Light Horse.

The numerical weakness of the Volunteer cavalry is certainly remarkable, yet the fact that, despite of the discouragement that must result from the absence of collateral emulation, isolated troops, amounting in all to some 700 sabres, continue to make themselves efficient, is in itself noteworthy evidence of the honest spirit that lies at the root of the movement. Nor are the efforts of the light horsemen of Fife and Forfar, of Hertfordshire, Huntingdon, and Lincolnshire, by any means to be despised. Should the evil day of invasion arrive before all our maritime countries have instituted some similar force, there can be little doubt but that a large amount of suffering will be inflicted on unarmed villages, owing to a deficiency of cavalry whereabouts to meet and repel the enemy's foraging parties.

Mounted Rifles.

The Mounted Rifles, although their total strength is now reduced to 150, may still boast that they have set the fashion of the latest phase of cavalry encounter, and to Colonel Bower belongs especially the distinction of having developed a system, which, according to Colonel Hamley's theory, might, if employed on a large scale, revolutionize continental warfare. All honour to the counties of Dumfries, of Roxburgh, and of Hants, for rising superior to the fear of seeming singular.

Engineers.

Of the Engineers, it will suffice to say that there were present at annual inspections about 6,000, while 7,000 out of the enrolled strength of 7,500 made themselves efficient. The value of this branch of the Volunteer force will best be shown by a statement of the names of the head-quarters of the various corps or administrative battalions. In the north, Glasgow and Jarrow-on-Tyne; in the centre, Leeds and Sheffield, and the Mersey group of Birkenhead, Liverpool, and St. Helen's; in the south, one at Peterborough, one at Bristol, and three in the Metropolitan District.

Artillery and Infantry.

Of Artillery, there are 51 brigades, of an average strength of 680 of all ranks; of Infantry, there are 206 battalions of 690. Of the former force, 28,000 were present at annual inspections; of the latter, 117,000. Of the one, 32,500 were efficient; of the other, 134,500.

Summary of Statistics.

These statistics can scarcely be otherwise than wearisome; but they are necessary as the concrete foundation of fact on which to rear the abstract structure of theory. They may be briefly summed up in the statement that 92 per cent. of the whole force complied during the past year with the War Office Regulations as to efficiency; while 82 per cent. were able to attend the inspection parade.

Continued Vitality of the Force.

Although the movement has been subjected to no ordinary amount of criticism, it retains all the vitality which inspired its origin; and the fact that there is every year a steady numerical increase of five or six thousand efficient must not be overlooked.

Opinion of "The Times" in 1859.

It now becomes my duty to ask your attention to three short extracts from published opinions on the general worth of the force. The first is from the *Times* summary for the year 1859. It runs as follows:—

"The rapid organization of Rifle Volunteers, if it perpetuates itself in a national custom, will have been by far the most important movement of the year. Conscious ability to protect the shores of England

"against all assailants will calm the susceptibility of popular feeling even when subjects of dispute with France unfortunately arise. "Two or three hundred thousand Volunteers, skilled in the use of the rifle and instructed in the rudiments of military discipline, would, in conjunction with the regular Army and Militia, outmatch any force which could find its way across the Channel. After a campaign of three months, many of the Volunteer regiments would be competent to take their place in a line of battle, and in the meantime they might with little assistance garrison all the strong places in the kingdom. In the contingency of an attack on Malta or Gibraltar, the existence of a sufficient domestic force would set the army at liberty for foreign service."

Of Captain de Grancy in 1871-2.

The second extract is from a sketch of the British Army, published by Captain de Mandat-Grancy, Military Attaché to the French Embassy in London. He says:—

"I have seen the Militia and Volunteers manœuvre with all the aplomb of veteran troops. I was present, in particular, at a field-day of 25,000 Volunteers at Brighton in the year 1872. Two bodies of 12,000 men each, under staffs selected from the regular army, were in movement against each other from 5 A.M. to 5 P.M. on ground the most broken and unfavourable to manœuvring that it would be possible to conceive. It was said that one Volunteer declared he had had enough of it, and fell out in violation of all discipline; the rest stayed out the field-day in a manner really remarkable."

My third and last quotation is from the speech made by the Right Honorable the Secretary of State for War on the occasion of bringing the Army Estimates under the notice of the House of Commons.

Of Mr. Secretary Hardy in 1877.

"And now I come to the Volunteers. This year there is an increase of payment, but it is an increase which is on account of the greater number of efficient Volunteers." Not only does Mr. Hardy make no disparaging reflection whatever on the force, but he proceeds to single out for especial commendation the memorable Hyde Park Review of the 1st July, 1876.

I do not think that I need say any more to prove that the Volunteer force is in as vital a condition now as when it first saw the light in 1859, and that those who are entrusted with the direction of its energies are anxious to avail themselves to the utmost of any opportunity that may be given them of still further developing its powers. Such opportunities, however, rarely offer themselves, and it is to the members of the great unpaid organization itself that we must look for the initiative in all measures of gradual progress.

Direction of Future Development.

As I have already stated, it is quite out of the question for me to attempt to put forward any complete scheme of re-organization, even were such a course desirable; but I do ask permission to be allowed to

suggest a method by which at no extra cost the present value of the force may be decidedly increased. Although allusion has been made to the present condition of the Light Horse, the Mounted Rifles, the Engineers, and the Artillery, as well as that of the Infantry, it is to the last-named arm to which I shall for the remainder of my address confine my remarks; for not only is it that which is easiest to handle, but it is also, so to speak, the central figure about which the others are grouped.

Destination of the Infantry Volunteer Force.

It will be sufficient, then, for the present purpose to ascertain the mode in which the War Office authorities propose to make use of the Volunteer Infantry. Thanks to a comparatively recent *communiqué* of a semi-official character, it is known that a part of the force called out will be employed in augmenting the strength of the garrison armies, while the remainder will be absorbed in the Coast Brigades system.

Coast Brigades.—Detachments in Garrison.

A study of pages 109, x to z, of the Army List, will show that the latter project principally affects those battalions of Volunteers which lie far away from the thickly-populated districts of the island, while reference to page 109, q to u, in the same publication, betrays the fact that only detachments of the other corps will be embodied in the garrison armies.

The "Civil Occupation" Objection.

This anomaly is defended by those who originated it, on the ground that it cannot reasonably be expected that more than one-fourth of the members of each corps of Volunteers will be able to absent themselves from civil work, even in case of an invasion being imminent.

I beg to be allowed to protest against this assumption. It is undoubtedly true that it would be impossible to maintain an army composed of Volunteers for any length of time at a considerable distance from the men's homes and places of business, but it is by no means certain that such a course is necessary. If, as was demonstrated by General Collinson in the second part of his lecture on Invasion, much time is consumed in moving a *corps d'armée* along a single line of railway, it by no means follows that, with a network of communications with the coast such as we possess, there would be any difficulty in concentrating a sufficient number of brigades in rear of a point seriously threatened by an enemy. The brigades might be formed to-morrow, and the men accustomed year by year to go under canvas, drilling at dawn and before sunset, and spending the day at their ordinary work. This is already done by some metropolitan battalions, and the *élite* of the rural corps, and there is no reason why the custom should not become universal. The men should have constant practice in striking and packing tents. With this the column of march might be formed at half an hour's notice, and the arrival of the news that a landing was imminent, would send whole battalions

and not mere detachments in whatever direction might seem good to the General in command.

Inadequacy of Mobilization Scheme.

It may be objected to this policy that these Volunteer brigades will not be wanted, that all the infantry required for service in the main field armies is already provided by the Line and the Militia, and that to make any further addition to the Mobilization Scheme would be, so to speak—

“To gild refined gold.”

Now it may be as well to arrive at a perfectly clear understanding of the position in which we stand at present, and of the danger that may by an untoward series of events come very close to our doors.

In Two Cases.

With this view I will lay before the meeting two cases in which the Mobilization Scheme, admirable as it is allowed to be in many respects, would fail to keep an enterprising enemy out of the heart of the country. Of these one is that of a foreign expedition being resolved on; the other that of the whole force being retained in the country, but being paralysed by a combined attack on various distant points.

CASE I.—Foreign Expedition takes away 54 Battalions.

In the first case, it is probable that two army corps would be ordered to embark on board transports, and as the complement of Infantry to an English corps is 21 battalions, it must be allowed that the 6 battalions of Foot Guards would, together with 36 battalions of the Line, be at once withdrawn from the Army of Home Defence. It is not too much to suppose that some 10 or 12 Militia regiments would also be shipped off to reinforce colonial garrisons, such as Malta, Gibraltar, or Bermuda. In this case, therefore, the present total of 123 battalions made up of the Guards, 45 Line, and 72 Militia regiments, would be reduced to 69, the deficiency being 54.

Unless the said deficiency is made good, the Mobilization Scheme would cease to be a reality.

CASE II.—Combined Attack on various Points of Coast Line.

In the second case it is premised that the foreign expedition spoken of above has been postponed in view of an imminent invasion; that this invasion is to be looked for, not from any one particular power, but from the combined forces of two or more states in permanent or temporary possession of the harbours of Brest, of Cherbourg, and of Wilhelmshaven. In these fancy sketches it is usual to consider the Channel and Reserve Squadrons to be either absent, annihilated, or overmatched, and there is, therefore, nothing especially out of the way in allowing the enemy's expeditionary fleets the unmolested right of way over the waters of the German Ocean, the English Channel, and the Irish Sea. General Collinson's estimate gave 150,000 as the

number of foes that could well be ferried across to our island within a very short period; let it be supposed then that each of the three expeditions consists of 50,000 men.

The Wilhelmshaven and Rotterdam Fleet will make for a point between the Wash and the Humber, and at once attempt to effect a landing on the shores of Lincolnshire. Its first object will be to possess itself of the city of Lincoln as a convenient base of operations either against the Leeds and Sheffield or the Birmingham and Stafford districts, nor will it find any obstacle to its progress save the rather scattered forces, some 20,000 in all, of the Seventh or York Army Corps, and such few coast brigades as may be collected on the spur of the moment. Under ordinary circumstances it might be expected that the Edinburgh and Melrose Divisions would at once be despatched as reinforcements from the north, that the Chester Corps would move over to East Retford, and that the metropolitan forces would be pushed forward by rail to Peterborough or Grantham. In this particular case, however, there is no chance of support coming from any quarter, for, while the Cherbourg expedition is selecting a landing-place on the coast of Sussex, and thus keeping the four corps grouped around London on the *qui vive*, that from Brest is lying under the lee of the cliffs of the Isle of Man, and, by its presence in this central position, at once menacing the Irish, the Scotch, and the Chester Army Corps.

Auxiliaries Available.

To what force can the York corps look for aid? Not to the Army Reserve, for that has long since been absorbed in bringing regiments of the line up to their full war strength; not to the Militia or Yeomanry, for they are already distributed over the various existing corps, but rather to that section of the Auxiliary Forces known as the Volunteers. In Yorkshire alone there are 14 infantry battalions, in Lancashire there are 20; Lanarkshire has as many as 10, and in Middlesex, independently of Surrey and Kent, there are no less than 28. Surely these 72 battalions might well be trained in time of peace to such a pitch of excellence as to be perfectly prepared—should such an occasion as that which I have endeavoured to demonstrate arise—to take the field with the full prospect of turning the tide in favour of an outnumbered and outflanked Army Corps. Let the possibility of their services being required be once conceded, and it becomes the duty of all who seek to make the Volunteer force something more than either a shooting club or a full-dress parade association, to enquire whether there is not some room for improvement even in its present very creditable condition.

How the Volunteers may be fitted for Field Service.

Now I must venture to remind those of my hearers, should there be any such, who were present at General Collinson's second lecture, that in the discussion that then ensued I ventured to lay before the meeting the method which struck me as being that best fitted for the development of the force to such an extent as to enable it to aspire to

play a more distinguished part in the defence of the island than that which is at present allotted to it.

On that occasion I suggested that the Volunteers would not be qualified to take part in field manoeuvres until the battalions had been reconstructed, until a system of brigades had been organized, and until adequate camp equipment had been provided. Although I hold very decided views on the last-named point, viz., the necessity of providing beforehand tents and blankets and other campaigning requisites, I will confine my observations to-day to the questions of the reconstruction of battalions and the organization of brigades. It will be to some perhaps a matter for regret that recourse must here again be had to statistics, but without the aid of figures it is difficult to convey an idea of the purport and scope of the proposed reconstruction.

Reconstruction of Battalions.

As has been already stated, there are now in existence 206 battalions of Volunteer infantry, of which number 120 are made up of small country corps and are termed administrative battalions, while the remaining 86 are able to stand each one by itself. Although the strength of these battalions varies considerably, a general idea may be formed of the available force by striking an average.

This process gives us for each battalion an enrolled strength of 690, an efficient strength of 650, and a still smaller total, 570, of those who were present at annual inspections.

The retired Members of the Force.

Before dealing with these figures a further element of our national resources must be considered, that, namely, of the trained men who have passed through the ranks. Independently of those who formed part of corps which are now extinct, the total number of those who have served in the infantry alone is given in a recently issued Parliamentary Return as 486,498, or not very far off 500,000. Now let us divide this figure by the number of battalions, 206. The result shows a past strength of 1,360 per battalion.

Of course it is clear that all these men are not now available. It is probably only fair to deduct one-fifth for those who are dead, one-third for those who are too old, and one-sixth for those who are in any way incapacitated, or for any reason indisposed to rejoin the force. These allowances will reduce our 1,360 reserve men per battalion to 408, but this latter figure may be taken as representing the net *unenrolled* strength of the volunteer infantry regiment. Add to it the *enrolled* strength, 690, and the disposable force per battalion is 1,098, or as nearly as possible 1,100. Supposing that the standard attained of physical and technical efficiency was equally high in each individual, we should be able to reckon on a fighting field force of 225,000 riflemen. This supposition unfortunately will not be entertained for a moment by anyone who has a general knowledge of the real condition of the force. On the contrary, he will find in one corps a company, or perhaps an entire battalion, rivalling the Foot Guards in *physique*

and the steadiness of its movements, in another about as ill-conditioned a lot of men as ever were seen in M. Gambetta's levy in the Franco-German war: in one perfect discipline, in another scarcely the semblance of a military virtue; in one able-bodied young men, in another crippled or unwieldy veterans. This state of things demands a remedy, and the remedy which commends itself to me most forcibly is that of sorting like with like, and of devoting each class to the range of duties for which it is best fitted. With this view let us analyse the composition of our average battalion, and, so to speak, melt it down in a crucible.

The Field Army Battalion.

First we require a marching and, if necessary, hand-to-hand fighting force; in fact, a field army battalion. Clearly we do not find it in the average enrolled strength, the 690, nor yet in the average efficient strength, the 650, nor even in the minimum total we have yet dealt with, the 570 present at annual inspections. It is not too much to expect that, when the crisis arrived, one-fifth of this minimum would be found to be unprepared to stand the wear and tear of forced marches, of outpost or frequently recurring sentry duty, of manoeuvring over rough ground, and of subsisting on reduced rations and under unhealthy conditions. Surely it would be wise in time of peace to ascertain which members of battalions are likely to be of real service in the field, and which will more probably stay away, or, if they do turn out, will load the ambulance waggons before a shot has been fired. It may be objected that Volunteers, when tried by severe tests at Aldershot and elsewhere, do not succumb under the ordeal, and that straggling is unknown on their line of march. This is true enough, but it should be remembered that these bodies, whether companies or battalions, rather represent my ideal of the marching and fighting force than the actual reality of the corps as it appears at the official inspection parade. When there is serious work to be done, the one-fifth avails itself of its privilege to be absent without leave.

It will be seen, then, that the selection policy, a policy as old as the days of Gideon, will reduce our hitherto *minimum* total to 456, that is to say, as nearly as may be a battalion of 8 companies of 25 file. This is a respectable unit, but it may well be expected that, so soon as it is seen from their constant exercise in military operations in the field, that the men who compose it have made up their minds to qualify for employment in the Army Corps system, members of those essentially athletic classes which fill our boating, and cricket and football clubs, will flock into the ranks, and that by vigorous recruiting the 8 companies will be increased to 12; the 456 total to 680.

Here it may be objected that by the formation of these field army battalions, the garrisons will be defrauded of the contingents allotted to them. This very reasonable protest brings me to my second item of the reconstructed battalion, viz., the sedentary force.

The Garrison, or Sedentary Battalion.

It should be borne in mind that the duties of infantry in the defence

of a fortress or fortified enclosure are twofold: in the first place to ward off attack by simple measures of defence; in the second, to carry the war into the enemy's lines. It is by no means necessary that the same description of troops should be employed for both purposes, and while sorties require all the vigour of highly trained field army regiments, the maintenance of entrenchments, and the lining of loopholed ramparts can be as well performed by dwarfs as by giants, by cripples as by athletes. A cool head, a clear eye, and a steady hand are the only requisites for the small-bore rifle shot, and although allusion has scarcely yet been made to the original theory on which the Volunteer force was based, it must not be left out of sight that sharpshooting has ever been its chief claim on national regard and support. Many a man who excels at the Carton ranges, cuts but a sorry figure in a "double" across a ploughed field. Let such an one be relegated to the sedentary or garrison battalions, and we shall no longer have the anomaly of round men in square holes, square men in round. To return to our statistics, what men have we available for this special sharpshooting duty? In the first place that one-fifth of the inspection parade which was "cast" when the field army battalion was called into existence, *i.e.*, on the average, 114. Next, those members of the corps who made themselves efficient, who did not appear at the inspection parade, in number 80; and finally the cream, say one-fourth of the net unenrolled reserve, 102. This gives us a total of 296, or close on 300 of all ranks for the sedentary battalion.

Reserve or Dépôt Battalion.

Here some would be inclined to stop, but it must be borne in mind that as yet no reserve force has been provided, and without such provision it is unadvisable to send a regiment on active service.

The material is ready at hand, for, as the "cadre" at the regimental dépôt, we have on the average 40 men who are enrolled, who pay their subscriptions, attend a few drills, and perhaps fire a few shots at a target, but who fail to make themselves efficient. They will form the nucleus about which will gather not only those numerous individuals who will clamour for admission to the ranks as soon as an invasion is imminent, but also the three-fourths of the "net unenrolled reserve," who were not sufficiently ardent or unoccupied to train for entry in the garrison battalions.

Independently of recruits, this reserve battalion would, on the average, number 346, *i.e.*, close on 350 of all ranks. Its value, not merely as a feeder in case of need to the first battalion, but also in an extreme emergency as an actual support to it on the field of battle, can scarcely be over-rated.

Summary of Reconstructed Battalions.

What, then, is the result of the project of the reconstruction of battalions?

In the first line we find 206 battalions, averaging 680 of all ranks,

ready to step up into the places, or otherwise to supplement the efforts of the regular or militia regiments in the Mobilized Army Corps.

Next we have an organized force, consisting of an equal number of battalions, averaging 300 of all ranks, especially well suited for the discharge of the duties required of sedentary troops.

Lastly, we find as many dépôt or reserve battalions, averaging 350 of all ranks, and daily swelled by ardent if untrained recruits, ready to fill up gaps or to strengthen weak points in a line of battle.

Brigade Organization.

The other main question which presents itself is that of brigade organization, and this is the inevitable consequence of the battalion reconstruction scheme. If it is decided that it is possible, instead of quartering battalions, to expand them into triplets, it becomes necessary to inquire whether there is in existence any method by which these battalions may be made more speedily available for active service than they are at present. It is hard to say which would be the more objectionable, a throng of battalions suddenly concentrated at a few points, and directed to act in concert with each other, although hitherto entirely unconnected, or a series of isolated corps straggling over the country, in a great measure at the discretion of the respective lieutenant-colonels in command. British regular regiments serve under such peculiar conditions, that a permanent working brigade organization has never been adopted for them, and therefore there is a prejudice against the adoption of such a system for the Volunteers. It may be doubted, however, whether this prejudice is well-founded. *Esprit de corps* is not necessarily confined to a battalion, it flourishes in brigades, and has even been known to bear good fruit in divisions, and two or three more battalions trained and accustomed to work together, would be far more valuable than the same number whose acquaintance with the application of the principles of mutual support was confined to the limited manœuvres of the Annual Brigade Drill, or the Easter Monday Review.

Lord Herbert of Lea on Volunteer Gatherings.

It may not be known to all here that some such organization as that which I now venture to recommend was distinctly contemplated by the founders of the force of 1859. In proof of this, I will read an extract from a letter written on the 7th July, 1860, by the then Secretary of State for War, Mr. Sidney Herbert, to His Royal Highness the General Commanding-in-Chief. After giving it as his opinion that the efficiency of the Volunteer Force would be promoted, and its permanence insured by opportunities being afforded to various corps for occasional gatherings for the purpose of being reviewed by Officers of high rank and position, and requesting that if it seemed fit to His Royal Highness the necessary directions might be given to the general Officers commanding districts, he proceeds to say—

“ By these means much encouragement would, in my opinion, be given to the Volunteer movement, the general Officers would be

"enabled to make themselves acquainted with the different corps "within their districts, and an opportunity (which it might otherwise "in many parts of the country be difficult to obtain), would be "afforded to the Volunteers for meeting together in considerable "bodies, and taking part in combined movements; and I have, "therefore, to request your Royal Highness's co-operation in carrying "ing this plan into effect."

It need scarcely be added that the co-operation asked for was cordially given, and that orders on the subject were very speedily issued both to Lords-Lieutenant of counties and general Officers commanding districts. I am not aware that these orders have ever been cancelled, although in some parts of the country they are not constantly acted on.

Yet, although the Volunteer Force has gained considerably both in Military experience and general efficiency since the date referred to, the practice, advocated by the late Lord Herbert of Lea, of promoting occasional assemblages of isolated corps is as necessary as ever. Such assemblages should not be spasmodic, but might well be regulated by the orders of a permanent brigadier who knew his men, understood the conditions under which they worked, and was determined to make the most of his command. The brigadier would be to the brigade what the lieutenant-colonel is to the battalion, and there is no reason for supposing that there are no retired Officers of sufficient position and means to maintain the dignity of the post, as well as of sufficient professional knowledge to enable them to discharge its duties satisfactorily. The novelty is no greater than that of welding scattered companies into compact battalions, yet no one would dream of abolishing battalion-drill on the ground that the gathering together of companies caused inconvenience, and that, for all practical purposes, the details of battalion movements could be acquired at company drill. Yet this is an argument often brought forward against the combination of corps in brigades.

In distinct opposition to this view, I would submit, that what is now especially needed in the Volunteer infantry force is frequent exercise in brigade movements in the field, for example, that three or four battalions should be grouped under one command, and manoeuvred as representing the advanced guard of an Army corps, or told off to defend or attack a half-mile breadth of difficult country; that they should go under canvas together, and learn by constant use the relative duties of the component parts of a brigade in camp; and that they should practise time marches by cross-roads, and encumbered with all their baggage.

The direct advantages of the adoption of such a system need not be urged on the attention of a meeting within these walls, but it may be as well to notice a few of the indirect advantages that would accrue from it.

In the first place, the Lieutenant Colonels commanding battalions, amongst whom at present the standard of efficiency varies considerably, would receive practical instruction in an extended range of duties, and would, by acquiring some knowledge of brigade drill,

qualify for succeeding to the brigadier's post, in the event of that Officer being put *hors de combat*.

Then, again, a great impetus would be given to recruiting by the frequent spectacle of large bodies of men under arms and engaged in military manoeuvres. A stimulus would be afforded to the growth in efficiency of each battalion by competition with others, and a shoulder-to-shoulder sentiment would be developed in the brigade more potent even than that already existing in the battalion.

Taking the strength of the average field army battalion of the first line as 680 of all ranks, a brigade of three battalions would have a total of about 2,050; and it is undeniable that 70 such units would be of far more value for tactical purposes than 206 isolated battalions.

Probable Objections to Brigade System.

It would be worse than foolish to ignore the many difficulties that will be likely to militate against the adoption of the brigade system; such, for instance, as those shadowed forth in the objections, that the time required for brigade drill might more profitably be employed in battalion exercises; that many corps lie too far apart to be capable of concentration; that the battalion commanders would resent a step which might seem to overshadow their dignity; that Volunteers never will be fit for field manoeuvre, and that it is idle to try to make them so.

Peroration.

That either this, the brigade organization, or the companion scheme of battalion reconstruction could with advantage be adopted at once and in its entirety, I do not at all believe; but that little by little both may be engrafted on the existing system; that here and there a cluster of battalions may be formed; that in this and that headquarters plans for the utilization of Reserves may be put into execution, is not too much to expect when one reflects on the vast achievements of the patriots of 1859.

With the outside world the difficulty to be met and grappled with is rather the aversion to any project which would tend to convert the island into an armed camp; the dread lest the military spirit should gain such a hold on the mind of the nation as to impel it to a policy of bravado and aggression. The apprehension is as natural as it is unfounded. The more universally the knowledge of the use of arms is spread over the country, the less inclined is the temper of the people to incur—save in the direct necessity—the horrors of war. When a man realizes that the weapon which he carries and which he is trained to use to destructive purpose is intended solely as a means of putting a fellow-creature to death or to great pain and consequent helplessness, he will, unless he is a morbid monster, think twice before he gives his vote for a bellicose policy. The same peace-loving and humane spirit will induce him to spare no pains, should justice compel his country to engage in war, to fight out the battle to the bitter end, and to annihilate the offensive power of his antagonist. It is cruel kindness to perform a surgical operation with a blunt instrument. It

is the height of folly to be only partially, instead of thoroughly, prepared for the extreme necessities of war. Therefore, it is the duty of all who love England, and who value at their true worth the boons of genuine freedom and security both of person and property, to strain every nerve in these days of at least ostensible peace, to place these favoured islands and all they contain far beyond the reach of the most grasping or turbulent foe. On this ground, and on this alone, I beg the co-operation, not only of this meeting, but of all who may become cognizant of these words, in the task which I have sketched out of the "Further Development of the Volunteer Force."

The CHAIRMAN: We are anxious to encourage discussion on the subject that has been put forward by Mr. Hoste, and as there are so many Officers present who understand the subject thoroughly, we shall no doubt have a very interesting and profitable discussion.

General CAVANAGH: Although I have not had the honour of being in any way connected with the Volunteer Army of England, yet, as a soldier of nearly forty years' standing, I have naturally taken an interest in a force which adds to the military strength of the empire, whilst it was my lot in the days of our trial in India to raise and command a corps of volunteers. Since my return to this country, I have taken every opportunity that has been afforded me to endeavour to make myself acquainted with the merits and perhaps the demerits of the volunteer system; and I must say, after attending several of their great reviews, I have been much struck with the evident necessity for requiring the volunteers to be instructed in brigade movements—for different regiments to be manœuvred together. Some years ago I submitted to the War Office a paper of recommendations on our military organization, and one of the points on which I laid great stress was the necessity of having a general Officer in every county, who should be the brigadier to command the reserve forces, and be responsible for their efficiency, who, when the militia were out for their training, should take the opportunity to establish brigades and exercise the militia and volunteers together as far as possible. Another defect in the volunteer system, and one on which I also remarked in that paper, is the mode of supplying the clothing. I pointed out that it is absolutely necessary that the volunteers should be efficient, and that I believed, as a volunteer gives his time to the country, it was the duty of the country to provide him with everything that was needed, so that he might be fully equipped. I had previously taken some little trouble to ascertain the cost of meeting these wants, and I believe under proper arrangements, the expense of actually providing the volunteers with everything that would be necessary to make them fit to take the field, would be very little more than that now entailed. I found in many volunteer corps, owing to the clothing having to be provided regimentally, they were unable to obtain their uniform at the same cost at which it might have been supplied by the Government, and the expense to different corps varied materially. In some corps it was more than double the cost of a sergeant's suit of clothing, and in every corps it was in excess of that amount.¹ The result at which I arrived was, that if the War Office would only take the trouble to give a little attention to the matter, and recognize the volunteer force as a most important part of our military organization, we should have an Army sufficiently strong and sufficiently efficient to render this country free from even the risk of invasion, and at very little more expense than is now incurred.

Major BAYLIS, 36th Middlesex Rifle Volunteers, Q.C.: I have been here on many evenings and afternoons, and have derived not only great pleasure but great instruction from being present at these meetings, and I consider it, as a volunteer Officer, a great privilege to be able to do so. I think some volunteer

¹ In 1868 the expense of supplying a volunteer with uniform averaged from 2*l.* 17*s.* to 4*l.* 17*s.* the cost of the uniform of a sergeant of the line was estimated at 2*l.* 0*s.* 6*d.*

Officer should say something on the most interesting subject connected with the present and future of our force. The paper that has just been read had for its title "The Further Development of the Volunteer Force." Now, "development" certainly embraces a great deal. I think it embraces what we must all wish to see, the greatest possible efficiency of the volunteer force, and the greatest possible utility of the force to the country, not only now but in case of need, so as now to give this country security and respect in the eyes of the world, and also render itself useful if the time should come for action; therefore, when it is said we are to discuss "the further development of the volunteer force," I think you may expect some of us, at all events, who are volunteer Officers, to say what we think ought to be done for "the further development of that force." I am one of those who think if a thing is not good it is not worth having at all. I know we are a great expense to the country, and if we are a sham and we cannot be relied on, we had better not exist at all; let the money rather be expended in having five or six good regiments than in having a force that cannot be relied upon. And in *these* days I do not think you can rely upon a force, unless it is an efficient force ready at any moment. With regard to the volunteer force I think there is this advantage, that we are ready at any moment for what we are worth. With regard to the militia force, they go out for a month's training once in the year, but after they are separated you could not get them together so rapidly as you could a volunteer force. Belonging as I do to a regiment 960 strong, I believe, in the course of twenty-four hours, we could muster 800 men; that would be acknowledged to be a great advantage. Then, what are they when they come together, and if they are not so good as they ought to be, what are the means to make them better? I think, as an old Officer of seventeen or eighteen years' standing, who has had the advantage of being at the first Autumn Manoeuvres and of passing the School of Instruction at Aldershot, that there are many things required. The one thing we want above all other things is gun drill. What is it that we are told will be our duty in case of war? Most likely it will be to hold the forts. Now, I have wished and prayed day after day and time after time, to see our men instructed in gunnery. I wish the Government would make a movement in that direction; that in every parade ground there should be a gun given by the Government, and that the men should be instructed in gunnery, because, most likely, it would be part of our duty to hold forts. Why should not we learn gun drill, when the marines and other branches of Her Majesty's forces have learnt gun drill as well as infantry drill? I think it is highly necessary that the Government should give us guns, and assist us to learn their use. Another advantage would be this. We all like novelty, and I believe the volunteer force would like to go into gun drill, not only on account of its great utility but because it would be a novelty; I should for my own part. Of course, when more money is given by the country to the volunteers, it ought to have increased efficiency in return, and I think I must say that the volunteers have responded to the call: and I believe where the Government has required so much of the volunteer force, they are ready to give still more; and if that be the case, surely they ought to be met with every encouragement. But the money given is not enough. I think there are certain further expenses which ought to be borne by the Government. If you want an efficient force you should put them in a state of efficiency. At present when they go down to reviews they have not their packs, they have not their great coats. If they get wet they have to get into the trains cold and wet; they have not their great coats yet. You would not do that with the line, therefore, I would say let great coats, packs, and other necessaries be supplied. I think also volunteers should be provided with the best weapons as soon as possible. When I go into the shooting field, as an old sportsman, I like to have the best weapon to kill a partridge or a pheasant, and surely the volunteer force ought to be armed with the rifle which the Government thinks it so important the line should have, and it is manifestly most inconvenient for the volunteers to be armed in the field with a weapon as at present, differing from that in the regulars in gauge and requiring a different sized ammunition. A great deal depends upon the bravery of the man, and his confidence in his weapon; therefore, I would say give him the best weapon. I hope the time will come when, whatever is found to be the best weapon, we shall be

armed with it. Why should an inferior weapon be given to an inferior force? Put into the hands of an inferior force a good weapon, and when they get to like it and feel confidence in it their efficiency will be increased. As for brigade movements, I felt years ago the necessity of being formed into and practised as little armies. I think we ought to have an opportunity of going out as brigades, and not only as brigades, but let us have all the forces together, so that we may act together as an army. I want, as a Volunteer Officer, to know the power of artillery and the efficiency of cavalry, because as an infantry Officer, if I know all these things I shall be able to do my duty better. If I know what cavalry and guns can do, surely I shall be better able to direct and take care of my men and put them into position. Therefore, I would say we want all these things, and I think it would be a great encouragement, if Officers could not only pass the infantry school at Aldershot, but go also to the cavalry school and the gunnery school. I think all these opportunities ought to be afforded us. There is another suggestion also, if you got some of the old Officers who had seen the different branches of the service and knew these things having the command of the volunteers, they would soon apply themselves and teach their men, and not only that they would thus give confidence to their men on parade, and in the field of battle confidence is everything; if the men have confidence in their Officers it is a great way to success. I think it cannot be denied that volunteers are intelligent, capable, and willing to learn, and we know that a military education at the present day is an exceedingly scientific one. A man requires not only strength of mind but also experience, and withal calmness, and education gives calmness, and I believe all these qualities will be developed in the volunteer force, if they have the opportunity given to them. But what stands in the way? It is the question of time and the question of money. You want men to leave their own occupations not only at their own expense, but at the cost of their time. How is that to be done? I think if a force is worth having, the Government would do well if, on the occasion of these brigade meetings, the men were paid for the day on which they go out, I think that would add greatly to the success of the force; as it is, it is a wonder what has been done. I go into Lancashire and find Lancashire regiments everywhere. They come up to the Easter Monday Review in stronger force than any other regiment; they come up to the Hyde Park Review, and why? Because the Officers put their hands in their pockets and pay the expenses. A money is required for the sinews of war, so is it required for the volunteer force. And so, because the Officers put their hands in their pockets and find the money, you find the Lancashire regiments the strongest regiments in the field, come up all the way from that northern country, not minding the time or the expense, but taking an interest in the welfare of the country; but all have not the means. I really think the men should be paid when they so come out. The militia are paid when they are called out for a month, and why should not something be done more than at present for the volunteers. On one occasion when General McMurdo inspected my regiment and distributed the marksmen's badge, he said: "Marksmen to the front!" Yes, he called forward the marksmen to whom he had to distribute the badge, and he said: "You will be the men to go forward to the front; you will be the men to be called out in case of an emergency; you will go down by train as fast as you can to the place where the enemy may be about to land, and there you will meet the foe. You won't want your great coats, because you will be in a friendly country, and you will draw all your resources from that country;" that was his view, but then you must have efficiency, you must not be content with the mere routine of parade drill! Parade drill is not enough, because, though a certain number of men attend very regularly, there are a great many who do not attend, and when they do attend they very much interfere with and paralyse our movements. That is simply the feeling of a volunteer Officer. I believe good can be done and that the service can be developed. I think it ought to be an honour to belong to that service which is for the defence of our own country, and I want to see a feeling instilled into the minds of men that it is so. I think the way in which they have responded to this movement shows that it is so. But there are certain limits they cannot go beyond; "*certi sunt denique fines*," they must attend to their professions. A man must attend to his ledger before he attends to his rifle;

he must attend to his profession before he attends to his sword ; but still he is willing to attend to his rifle and his sword, and being willing, he must, I would suggest, be further assisted by the Government, because his time to him is money. I believe those are the most important topics for our discussion connected with "the further development of the force." With regard to the Officers, I should like to mention one thing in which they might be greatly encouraged at a very little or no expense, and that is this : I have served as a volunteer Officer for seventeen years, and have passed through every grade from that of a private upwards. I am now entitled to retire on full rank. Why should not I, if I wish to stay, as an old Officer, still active and able, have the brevet rank which is conceded to Officers in the militia ? We have applied for it, and it has been refused to us, and I want to ask respectfully why should we be placed in a position in this respect in which the militia are not placed ? Why should I be met with this rejoinder, " You may "remain, but you shall not have your brevet rank ? " I say that if the Government can further see their way how they can please the volunteers by acceding to their wishes to become more useful and more efficient, we, as volunteers, will do everything in our power to carry out their ends. I submit that these considerations are at any rate worth the attention of the authorities.

Colonel DU PLAT TAYLOR : There seems to be some hesitation on the part of volunteer Officers to express their views to-day, and although I did not come here with any intention of speaking, yet, for the credit of the volunteer service, I shall be glad to make a few observations. I would remark that if the meeting had been held in the evening, this theatre would have been filled to overflowing, but it is only at a great sacrifice that volunteer Officers, most of whom are engaged during the day, can be here at three o'clock in the afternoon. I should have brought every Officer in my regiment if the meeting had been held in the evening.

I regret that I cannot entirely agree with Mr. Hoste in respect to volunteer brigades. From having had the distinction of commanding provisional battalions of volunteers at camps of exercise and manœuvres for the last six years, I am convinced that the greatest benefit is derived from those occasions when the volunteers are associated with regular troops.

The volunteer is essentially an imitative being, and learns more from seeing the steady drill, the discipline and smartness of a regular regiment, than from all the instruction we can give him. The close association of volunteers with the regulars was the great and only advantage of the Autumn Manœuvres, but actual steady drill was not learned, and I strongly recommended the War Office not to let the volunteers join them.

I wish it could be managed in camps of exercise that the regiments of the regular service should be encamped on the same ground with the volunteers. It is, I know, a tax upon the regular troops to keep them under canvas after their regular work is over ; but I hope this year volunteers may get to Aldershot before the troops have gone into barracks.

General Cavanagh made some remarks as to volunteer clothing, and dwelt strongly on the great disadvantage of having volunteers in different uniforms. I entirely agree with him, and a piebald provisional battalion, such as we see at Aldershot, is the most unhappy object imaginable, and however well the men may drill, and however steady they may be in the ranks, they never can present a really satisfactory appearance. I wish the Government would take this matter into their serious consideration. No doubt a large expense is involved in fitting out all the infantry volunteers complete with new uniforms, but it might be arranged that, while retaining the present head dress, accoutrements, and trowsers, every volunteer should be supplied by Government with a scarlet patrol jacket, which, I believe, would not cost ten shillings, leaving the volunteers to alter shakos, and trowsers, and accoutrements by degrees and at their own expense. With regard to the efficiency of volunteers, I entirely agree with Mr. Hoste, that volunteer battalions should be divided into classes, not merely in regard to the physical capabilities of the men, but also in regard to their drill efficiency. The first class should be subjected to a very much larger number of drills than volunteers are required to undergo. Military men must know that if every volunteer attended only nine annually—the War Office requirements—the force would be simply a rabble. It is

only because in every regiment a very large proportion of the men attend a very large number of drills and so form a good solid framework, that volunteer regiments are fairly efficient ; and I hope that if ever a scheme be carried for dividing volunteers into classes, the highest class will be required to attend at least fifty drills a year. I am sorry to say with regard to the Officers that the examination has latterly drifted into the old style. Two years ago a regiment which I know very well had nine Officers passed at the inspection. The Inspecting Officer, an old friend of mine, informed me in reply to my inquiry, "How he could pass those ' nine Officers ?'" said. "The fact was, when I was sent to inspect that regiment " and they had been drilled for a quarter of an hour or so—it was getting dark—the " Colonel stated he had nine Officers to pass, I asked them one or two questions, " and what could I do ? I had to pass them." I think every Officer in the Volunteer Army should either go through a thorough examination before a Board or should go through the schools of instruction.

With regard to the instruction of Officers after appointment, I have insisted upon all Officers and non-commissioned Officers of my regiment attending skeleton drills. In volunteer regiments we never can get the rank and file to attend with sufficient frequency to impart thorough instruction to the Officers and non-commissioned Officers. The men are assembled for battalion drills perhaps six or eight times a year, but the drills are frequently done in a hurry and there is no opportunity for Officers' instruction. By means of these skeleton drills, which I hold twice every week during the season, at which every Officer and non-commissioned Officer is compelled to attend, I am able thoroughly to instruct my Officers, and if several volunteer regiments, after having first instructed their Officers in this way in battalion movements, met for skeleton brigade drill, they would derive very much benefit from it. Brigade drill I take it is mainly useful for the instruction of field Officers, and the rudiments of this drill can be just as well taught at skeleton drill as with a complete regiment, and I should like to see these drills made compulsory by the War Office for Officers and non-commissioned Officers.

Lieutenant-Colonel HOWARD VINCENT: I have waited until this period of the discussion, in the hope that some Officer with longer volunteer experience than myself would have enunciated the facts uppermost in my mind, and so have relieved me of the task which I rise to undertake. I especially regret that my good friend Colonel Gordon Ives is absent from England, as he would have been far better fitted to undertake this duty. The facts of which I wish to speak are three in number :—Firstly, as to the Officers ; secondly, as to the men ; and thirdly, as to finance. Believe me, Sir, to the Officers of my own regiment I am attached by many an affectionate tie ; it is not of them, therefore, that I speak. They are zealous, many of them highly efficient, but yet I do proclaim it aloud, that the officering of the volunteer force is its weakest element. Within this very Institution, a few days ago, an Officer of the highest rank, liberal minded, an admirer and a practical encourager of volunteers, said to me, "Of this I am certain, that the non-commissioned Officers and men have improved in far greater proportion than the ' Officers.' " I have every reason to know that that Officer had well considered his opinion, and the fact is sufficiently serious without further comment. Suffer me, however, to read you an extract from the *Bombay Gazette* of March 17. It represents perhaps rather too strongly, but, however, I think truly, what is the real state of the case. I would not, however, be understood as presuming to imply in any way that every volunteer Officer, *pur et simple*, is unfitted for the position he holds—quite the contrary—many that I see here, many that I have the honour of knowing, are infinitely better suited to command their regiments, where personal influence is one of the greatest elements of efficiency, than any ex-linesman could possibly be, or any hero of a hundred fights. The extract is as follows :— " Of late " militia Officers have greatly improved, and there are few regiments which do not " possess half-a-dozen ex-soldiers. With the volunteers the case is different. " There the non-commissioned Officers and men are of splendid material, bound by " legal agreement and Act of Parliament to serve for a given time and efficiently. " But the Officers are of very inferior calibre for the most part. They neither " know their work nor are willing to learn it. If remonstrated with they resign " and cannot be replaced, for the expense and trouble is far from small. If, how-

"ever, the Government took the matter in hand, and insisted on all field Officers and captains having passed through the Army, the gain would be great. They should give them the same pay as in the militia, *i.e.*, thirty days, and no Officer should be allowed to enter the Army without undertaking subject to a pecuniary indemnity if he leaves it before the expiration of five years, to serve at least five years in the auxiliary forces. There are so many candidates, rarely less than seven, for every commission, that almost any difficulty can be placed in the way. Many men—the majority probably of those who leave the Army—go into business. If they join the militia, their partner insists upon the annual training being regarded in the light of a holiday. If, therefore, the volunteer force, especially in the large towns, were open to such Officers, and was equally advantageous as to pay, very many would select it in preference to the militia, for their annual soldiering would be spread over the whole year, and interfere in no way with their civil duties." This, as I said, represents perhaps rather too strongly, yet truly, what is the real state of the case. Some such system must in time be established and proper Officers obtained. Without proper Officers when the volunteer force is put on its trial it must break down. And I do say it is unfair upon Officers commanding regiments to throw upon them the extraordinary burden of finding efficient Officers for their regiments. The difficulty passes all conception, yet the Promotion and Retirement Warrant is going forth to the country without amending the situation one whit. Now, as to the men, as the *Bombay Gazette* said, they are highly efficient, they are splendid material, bound by legal agreement and Act of Parliament to serve for a given time and efficiently. They are under great control, but I say, and I say it advisedly, that many regiments are rendered absolutely useless by harassing committees and preposterous rules. This was the case in my own regiment. Now the coast is clear, but the experiment was extremely hazardous. I ought not to have been called upon to make that experiment, and the fact of the men having consented to be bound by stricter rules, shows that they like being treated as soldiers and not potted as spoilt children. Then, as to finance we are crippled by want of means. An Easter Monday Review costs 100*l.*, and we have to pay the expenses. It runs away with a very large proportion of the year's income. If the volunteers are worth having at all, as Major Baylis said, they are worth fostering and encouraging by every possible means. Tell me in what other country would the volunteers have met with such resistance, or would they have overcome such determined opposition in many quarters? Increase the present vote of half a million to a million, and you will have 200,000 absolutely reliable men. Pray Heaven that there may be some one here, or in another place, who will have the patriotism to move for a Royal Commission, to inquire into the working of the volunteer force. Knights of shires, borough members, military politicians, can you possibly be so indifferent to the backbone, I repeat it, the backbone of the defensive system of this great country? Let the recommendations of the Commission be adopted, let proper Officers be obtained, let a uniform system of drill and discipline be established, and we shall be impregnable, invincible.

Col. Lord RANELAGH: Some observations that have fallen from the gallant colonel necessitate my making one or two remarks, and it is with considerable regret that I do so. I have heard, and heard with astonishment, his depreciation of the Officers of the volunteer force, I presume generally. What may happen in his regiment I sincerely trust does not take place in every regiment, at all events, in my regiment. When it was first formed, I believe nearly every Officer in the regiment was a military man, and I can only say the experience I have gained of those who succeeded these military Officers shows that they, though civilians, are quite equal to their predecessors. They were men who put their whole hearts and souls into their profession, who day and night, I presume, were studying those regulations and books that after all do impart knowledge, and the result is, I have a body of Officers whom I consider perfectly equal to those of any regiment in Her Majesty's service at the present moment. Therefore I say it, I regret the words that have fallen from the gallant colonel, who is very young in the service. I have the advantage of being his senior, and I address you these few words in defence of, I believe, the Officers of the volunteer force as a body. But you are all as capable of judging as I am myself

—when you take up the *Gazette* you will find most of those Officers have the "S," or "P.S." after their names, showing that they have passed through the school. They are not among my friend Colonel Taylor's nine men who got the "P" put after them, but most of them passed through the school, and I think there is no gentleman in this room would tell me that a man who has passed through the ordeal of the school of which you, Colonel Fletcher, must be well aware, cannot but be as good an Officer as any man in the service. He has learned his work, and having done so, ought to be considered equal to his position as an Officer. I do not know that there is any difference in an Englishman whether he wears a red coat or a grey coat. I am sure they are of the same calibre, and have the same power of learning their duties.

Colonel VINCENT: I particularly guarded myself from saying that such a state of affairs existed in my own regiment, or even implying that it did.

Major ROLLESTON: I should like to say a few words in support of what my friend has said as regards the Officers of volunteer regiments. I have had some little experience of volunteer regiments, and I have found as a rule the Officers are the weakest point. Great stress has been laid on the fact of Officers having "P.S." after their names. Some of the worst Officers I know in the Service have got the "P.S." They go to the school, and learn in parrot-like fashion to give certain words of command in routine fashion, but they can do nothing else. Of course it is right that one uniform system of drill should be learnt in the Army, but they learn nothing but drill. Now, of course, with regiments constituted like volunteer regiments are, it is absolutely necessary that the Officers should be men of the highest military training. I should begin myself by sweeping away all civilian colonels and field Officers. Every colonel and field Officer should be an Officer on full pay of the regular Army. We have been told that great expense is incurred by Volunteer colonels, and that is a reason why no full-pay colonel would take a command.¹ Well, no doubt it is right they should pay. In the regular Army a man has to pay for being a colonel, and why should a man who has stopped at home all his life, and has taken to soldiering late in life have the same rank and position of another man who has given the best years of his life to it, unless he pays for it. As regards men, you may get any quantity of men to join the ranks if you only have all the colonels and field Officers men in full pay of the regular Army. The volunteer service, I have no doubt, of late years has increased in efficiency, and it is owing to the fact that our adjutants are connected with the regular Army. They have infused a better spirit into the force. The old place of adjutant was not an easy berth, they were obliged almost to prophesy smooth things to their colonels. Those men have been swept away, and we are now getting men from the regular Army. And where those men do do their duty, though no doubt it is a hard thing for a good man from the Army to go into a volunteer regiment, and to find that in many cases prejudice is brought to bear against him, and that he is treated in a way he does not like, and very often he gives it up in disgust, but if a good adjutant will only persevere, he will soon find the men will respond to it. I should like to see all colonels and field Officers of the volunteer force men on full pay in the regular Army, for we should then have a force really and truly reliable. If ever an invasion of England is attempted, it will not be when the regulars and militia are at home; there will be the volunteers alone, and I would ask any military man here present what sort of show he would think that a volunteer regiment led by a volunteer colonel would make, plucky though Englishmen are, against any foreign regiment.

Lieutenant-Colonel MALET: Some remarks that have fallen from my gallant friend

¹ What I wanted to urge about the expense supposed to accompany the command of a volunteer regiment is this: that when a civilian is appointed colonel or major the men naturally say, "Here is a man who knows no more about soldiering than we do, and if he wants us to turn out in force, so that he may show off at the head of a body of men, he must pay us in some way or another." Whereas if a lieutenant-colonel or major upon full pay of the regular Army was appointed, the men would feel that there was a "reality" in the whole business, and would want no inducements to turn out.

opposite induce me to take the liberty of trespassing for a few moments upon the attention of this meeting, which I do with the greatest diffidence. However, from the fact of my no longer holding a commission in the volunteer force, I am in a position to speak with more independence than I perhaps could have ventured to do if I had felt myself trammelled to a certain extent by the fact of holding a commission. It happened to me in the year 1870 to have the honour of being appointed, after retirement from the regular Army, to the command of a regiment of metropolitan volunteers, and I must say I feel bound to endorse the statement that there was in that regiment a system which rendered command almost an impossibility. I found a system of committees, and it was impossible to go on commanding that regiment, because there was this perpetual antagonism. I do not think there was any disposition to thwart the commanding Officer, but there had cropped up a sort of series of excrescences of fungoid growth, so that always in every direction there was a committee to be consulted. It was the most hopeless thing possible. At last I had to go to the War Office, and brought down a sweeping order, which put an end to the whole thing, and I was left face to face with a very angry and discontented element. I took counsel with a number of the best supporters I had, and after a time we found things smoothed themselves down; a great many people were very discontented in the battalion. A certain number of men retired, but the Officers supported me well, and showed a very good spirit. I shall always feel indebted for the way in which the Officers of the battalion came forward. The result was that very much more stringent rules were enacted, a great deal more power was given to the commanding Officers. The ranks filled very rapidly, and I had at the time I retired a very much stronger battalion than I began with. That proves what a very good spirit there is in the volunteer force, but it must be treated in a proper way; and I am very much inclined to support those gentlemen who are of opinion that Officers of the regular Army would be of great use in developing the volunteer forces. A power to command is a thing of very slow growth. You do meet occasionally a man who has it innate in him, but that is rather the exception than the rule, and every man who has one fine day to take upon himself the responsibility of leading a battalion under difficult circumstances will be all the better if he has had some years' training in the regular Army. I think under those circumstances the Government would do very well if they gave encouragement to Officers from the regular Army to join volunteer regiments, but I am not by any means disposed to sweep away all field Officers who have not served in the regular Army. I think that would discourage a great number of most excellent Officers. But let us do all in our power to bring forward Officers who have served in the regular Army, and induce them to take commissions in the volunteer force.

Sir WILLIAM CODRINGTON: As the volunteer Officers have had their say, I wish to say a few words on the general subject. We have heard a great deal against the volunteer system, but I hope the volunteer Officers will take heart in the feeling that I am sure is prevalent in the country, as well as in the Army, that they are an admirable assistance to the defence of the empire. While laying down that general principle, every one must feel that it is not five minutes, it is not five days, it is not even five months that give the true military feeling to the soldier in the ranks. What the volunteers require, and what a battalion requires, is the feeling of shoulder to shoulder, of confidence in each other, and of confidence in their Officers. Those are things you cannot always expect either in the militia or in the volunteers when assembling for so short a time. I hope the volunteer Officers will not agree with everything that has been said, namely, the depreciation of the volunteers rather than their laudation. I do not mean they should be unduly lauded, but I think every person must feel the advantage of having 186,000 men who volunteer to learn a most important part of their duty, namely to fire upon an enemy if that enemy comes, in order to defend the country. The country looks to them for this. I hope they will maintain and even improve in this service, and if they will keep up the discipline that the country must expect from any armed body, they will be estimated at their full value. I should be very sorry if depreciation of the volunteers should be the order of this meeting, rather than what I thoroughly feel, namely, the great praise that is due to them.

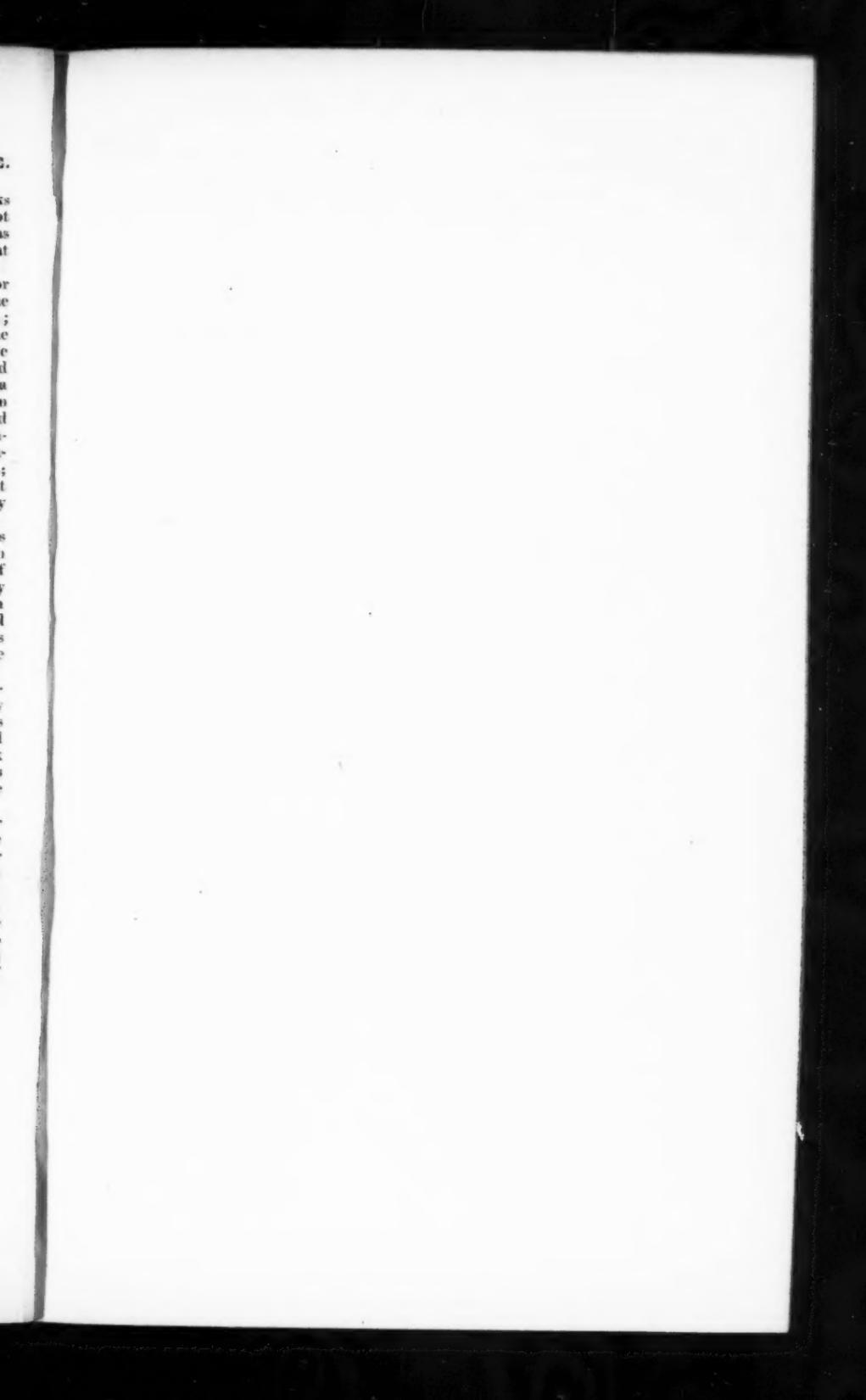
Mr. HOSTE: It would be the height of presumption in me to make any remarks on those observations that have been addressed to the meeting, which were not entirely germane to the contents of my paper. The discussion we have heard has ranged over a wide field, and I think that this fact fully justifies my having brought the subject before the Institution.

I should, however, like to make one remark on what fell from Colonel Taylor with reference to the brigades. I cannot think that Colonel Taylor, although he deprecated the formation of volunteer brigades, is really opposed to my project; for his verdict was based on the idea that this project would tend to separate the volunteers from the regulars. Now, I should be very sorry that anything I have said to-day should have the effect of loosening the connection so happily established at Aldershot between the regulars and the volunteers. I fail to see that such a result is necessarily to be looked for. Surely you could have your brigade in London doing its drill during the winter and spring, while in the summer this brigade could send a detachment to Aldershot of sufficient strength to stand on parade as a battalion. At present battalions send a company, or even so small a body as half a company, to Aldershot, and the regimental feeling is for a time almost entirely lost; therefore it seems to me if you establish your brigade in London, and send from it a detachment to Aldershot, you would satisfy both Colonel Taylor's ideas and my own.

The CHAIRMAN: Mr. Hoste at the commencement of his lecture expressed his acknowledgments to the Council of the United Service Institution for giving him an opportunity of putting forward his views; I, on the other hand, think it is a part of the duty of the Council, and the meeting here, to thank Mr. Hoste for the very interesting paper he has just read. I believe there are few subjects connected with the Army of more importance than that which Mr. Hoste has touched upon, and notwithstanding what Major Baylis has said, I think that the general interest that is shown in the subject has been evinced by the numbers and by the class of people who have attended this meeting.

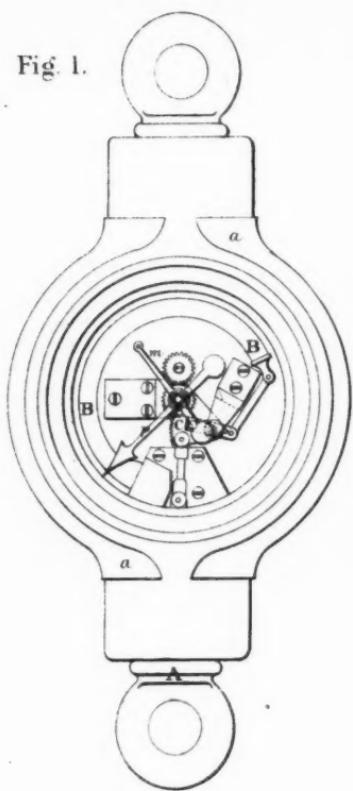
I have had several opportunities of commanding volunteers, and am able to express my great appreciation of their high qualities, and had also an opportunity during the American war of seeing regiments raised from precisely the same class as our volunteers, and I know how easy it was to maintain discipline among them, and how excellently their work was performed. There was a regiment from New York of a class very similar to that from which some of our best metropolitan regiments are raised, which at the siege of York Town undertook the hardest work in the trenches, and performed it remarkably well.

I must say that I think it is a very healthy sign of the condition of the volunteer force when the criticisms come from its members, and when the regular Officers take rather the other line. I should like to refer to one remark that fell from Major Rolleston. Almost every morning I see the volunteer Officers going through what I must call the drudgery of the schools of instruction, and I admire the regularity of their attendance and the zeal which they show. Of course drill is only intended to be the alphabet of the profession, and it is only drill that is taught at these schools. Afterwards Officers must educate themselves, or take proper means to obtain tactical instruction. This is what we all want—drill supplemented by tactical instruction. And the knowledge can best be obtained by taking the opportunity of attending at the manoeuvres, and observing how troops act in this imitation of actual service, if the opportunity does not offer of seeing them in actual warfare.



ELEVATION.

Fig. 1.



SECTION.

Fig. 2.

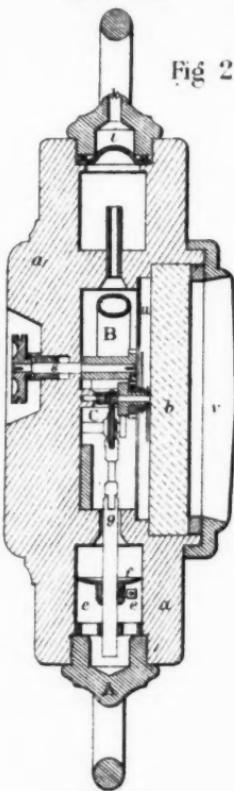
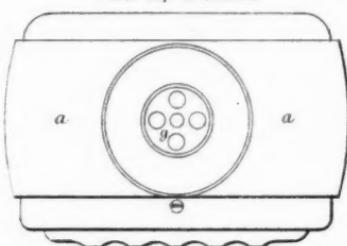


Fig. 3.

PLAN.

Screw cap A removed



REFERENCE.

- A. Screw cap.
- B. Sealed Bourdon tube.
- C. Toothed Sector.
- a. Metal Case.
- b. Glass Case.
- e. Cylinder full of Glycerine.
- f. Piston fitting loosely.
- g. Rod connected to C.
- i. Elastic diaphragm.
- k. Orifice in Gland.
- o. Pinion on indicating arm.
- p. Maximum indicator.
- r. Pinion.
- s. Set Rod moved by thumb-screw outside case.
- u. Dial plate.
- v. Protecting cage.

III

BUCKNILL AND CASELLA'S PATENT SEA-SOUNDING APPARATUS FOR NAVIGATING PURPOSES.

By Lieut. BUCKNILL, R.E.¹

IN 1870, when on board one of H.M.'s ships, and again in 1872 on one of the Allen Line steamers, the great difficulty in obtaining a reliable deep sea sounding came under my observation, and the idea of measuring the depth by means of a pressure gauge lowered with the sounding lead occurred to me.

The first pattern of such an apparatus was made for me by an American firm at Boston, Mass., and it left the city 24 hours before the great fire which entirely destroyed the plant and buildings of the firm. In this pattern a Bourdon gauge was employed, the moving parts being balanced in accordance with Lane's patent. The Bourdon tube was hermetically sealed, and the varying pressure was brought to bear upon the exterior of the tube. This was effected by filling the gauge with glycerine, the external water pressure being carried to the glycerine through an elastic diaphragm placed in a suitable position on the side or end of the metal jacket. In this arrangement a thin glass over the dial could be used, because the pressure on the exterior was communicated to the interior. Experiments with this instrument showed that blows on the exterior produced inaccuracies in the maximum readings.

Mr. Casella, the well-known instrument maker to the Admiralty, the Ordnance, &c., now took the matter up, and several instruments were made, differing much from my pattern. Eventually, however, it was found expedient to return to an arrangement of the Bourdon tube, and an efficient governor for controlling the moving parts and preventing fluctuations and inaccuracies of the maximum indicator, designed by Mr. Casella, was embodied in the instrument, drawings of which are given in Plate, Figs. 1, 2, 3.

The metal case with glass face is nearly filled with a transparent and stable fluid, such as glycerine. The cylinder at one end of the case contains a loosely fitting piston, clamped to a rod, which is fixed to some convenient part of the motion. The hole in the cylinder-cover, through which the rod is taken, is made slightly larger than the rod. The maximum indicator is actuated in one direction only by the projection on the indicating arm, and is set at zero by the set-rod, which passes through a stuffing-box, and is connected to a thumb-screw outside the case. The screw cap and ring at one end of the case is

¹ Read at the evening meeting on Monday, January 29th. Admiral of the Fleet Sir Henry J. Codrington, K.C.B., in the Chair.

perforated with a small hole, which gives the salt water free access to the outside of the elastic diaphragm.

The thickness of the glass face is only given in order to guard against its fracture from a blow.

I am assured by Officers, both of the Royal Navy and of the great ocean steamship companies, that a trustworthy sounding apparatus for navigating purposes is much required.

The ordinary lead cannot be relied upon when taking soundings of over 100 fathoms, and not long since I was informed of the following incident, which distinctly proves the assertion.

A large passenger steamer was making the American coast in thick weather, which had prevented any observation of the sun for several days. The captain stopped his vessel and took a sounding with an ordinary heavy lead. There was apparently no hitch of any kind, and "no bottom at 100 fathoms," induced the captain (a cautious and intelligent officer) to proceed at a fair speed. Shortly afterwards the look-out despaired "breakers ahead," and the ship was only stopped just in time to prevent a great catastrophe. If the sounding had been correct the ship would have been 30 miles from the breakers.

I have myself witnessed the inaccurate results obtained from those sounding apparatus, in which clock-work is driven by a fan revolving in the water as the lead sinks, and I think it will be safe to assert that the sounding apparatus now before you is much more easily used in rough weather than the apparatus designed by Sir William Thomson, in which a wire runs off a reel which is thrown overboard and floats behind the vessel.

It is not considered that the ingenious bathometer designed by Messrs. Siemens Brothers, and described in the *Times* of the 28th February, 1876, will obviate the necessity of taking soundings; but on the contrary, that the chief use of a Siemens' bathometer will be to indicate when it is necessary or advisable to take an accurate sounding.

The apparatus now before you has been designed in order to enable vessels to take accurate soundings to depths of 180 to 200 fathoms, though, if required, the sounders may be had to record greater depths. It is actuated by the water pressure, which varies directly as the depth. The specific gravity of salt water varies but little in different parts of the world, the difference between the extremes being less than $1\frac{1}{2}$ per cent. The average weight of salt water is 64 $\frac{1}{4}$ lbs. per cubic foot, and the instruments are graduated to read to fathoms when submerged in water of the above density.

The apparatus should be used as follows:—An ordinary lead is attached 6 feet below the lower eye of the instrument, and the end of an ordinary sounding line is rove through the upper eye. The maximum reader or indicating arm is then placed at zero, by means of the thumb-screw at the back, and the instrument and lead are thrown overboard. As soon as a decrease in the tension on the line shows that the instrument has reached the bottom, it is again brought to the surface, and the number of fathoms it sank will be recorded by the maximum reader on the dial. The length of the sounding line should not exceed the depth to which the instrument is graduated.

The advantages claimed for this sounding apparatus, are as follows:—

1. That accurate soundings can be taken without entirely stopping a vessel's way, which is sometimes a matter of great difficulty.
2. That under-currents which prevent the line taking a true vertical direction, do not impair the accuracy of this instrument.
3. That its action being independent of its motion through the water, its accuracy is not affected by the moving parts being lubricated, either too much or too little, as no lubrication is required.

The price of the instrument is 10*l.*

The weight of salt water in different parts of the world differs but little.

This is shown in the following table.

Pressures in pounds on the square inch at various depths below the surface at 60 degrees Fahrenheit.

Depth in fathoms.	Pressure in pounds on square inch.			
	Distilled water.	Baltic.	Atlantic.	Mediterranean.
24	62.50	63.44	64.25	64.31
48	125.00	126.88	128.50	128.62
72	187.50	190.32	192.75	192.93
96	250.00	253.76	257.00	257.24
120	312.50	317.20	321.25	321.55
144	375.00	380.64	385.50	385.86
168	437.50	444.08	449.75	450.17

The effect of temperature on the accuracy of the sounder is inappreciable.

This is shown in the following table.

Pressures in pounds on the square inch at 24 fathoms below the surface at various Temperatures.

Temperature in degrees Fahr.	Distilled water.	Baltic.	Atlantic.	Mediterranean.
35°	62.556	63.406	64.306	64.366
40°	.558	.498	.308	.368
45°	.555	.495	.305	.365
50°	.536	.476	.286	.346
55°	.524	.464	.274	.334
60°	.500	.440	.250	.310
65°	.469			
70°	.434			
75°	.394			
80°	.349			

The Admiralty are now trying one of our sounders, similar to that shown in the Plate, and a foreign Government has also obtained one for trial and experiment.

In answer to a question by the Chairman asking if the gauge had been tried, Mr. Casella said that, though only now introduced, he believed it had been tried at sea, but it certainly had been tested in its manufacture, as he had the means of testing each gauge in water by his hydraulic apparatus, which had been expressly arranged to test the compressibility of thermometers and various substances in water at any depth. The capabilities of each gauge were thus perfectly known at the time of manufacture. This mode of testing was quite open for the inspection of any one taking interest in the matter.

at
ne

ed,
at
at-
sly
ter
the
ny

OCCASIONAL PAPERS, NOTES,

AND

NOTICES OF BOOKS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications, or books for review, may be addressed to

MAJOR LONSDALE A. HALE,
Royal Engineers,
Royal United Service Institution,
Whitehall Yard, London, S.W.

THE EMPLOYMENT OF ARTILLERY IN CONNECTION WITH THE OTHER ARMS.¹

By Captain EDWARD O. HOLLIST, R.A., Department of Artillery Studies.

SINCE the author of the *Tactical Retrospect* wrote his severe strictures on the action of the Prussian artillery during the brief campaign of 1866, a vast literature has appeared, embracing the experience of the campaign of 1870-71, in which that service attained its present position. Nevertheless the Germans have re-armed their artillery, and in the two books before us are the regulations which govern the employment of the arm.² The "Field Artillery Exercises" of 1876 differs from its predecessor principally in the 5th section, which treats of the combat of artillery, and as it is the most interesting portion of the work, the remainder consisting of drill and parade manœuvres, we shall confine our attention mainly to the former. Major Hoffbauer is already known as the writer of detailed narratives of the exploits of the German artillery in the earlier battles of the late war, while his present work is a general treatise on field artillery tactics, for which the "Field Artillery Exercises" forms the ground work. We shall here give the whole of the 5th section of this work, and extracts (between inverted commas) from Hoffbauer's book, which may appear appropriate as comments or illustrations of it.

General Observations.

Artillery fire is employed at distances beyond the effective range of musketry, but this maxim by no means precludes artillery from approaching the enemy at decisive moments, although by doing so it becomes exposed to his rifles.

There are phases of a battle which require artillery to keep its ground to the last moment, especially when it is essential to hold a position, and then the loss of guns is not only justifiable but honourable. No fixed rules exist for the distance at which artillery opens fire, as this depends generally on the ground; but, as a rule, 2,600 yards are a limit to favourable action, although for purposes of detaining or occupying the enemy, longer ranges are employed.

It is in all cases important to meet the enemy from the first with a superior number of guns; this, on the one hand, necessitates placing the guns near the head of the columns of march, and on the other, leads to an early development of fire and to massing them, while the other arms are coming into action either in force or by degrees.

¹ Entwurf zu einem Exercir-Reglement für die Feld-Artillerie der Königlich-Preussischen Armee.

² Taktik der Feld-Artillerie unter eingehender Berücksichtigung der Erfahrungen der Kriege von 1866 und 1870-71. Von E. Hoffbauer, Major im 2. Badischen Feld-Artillerie-Regiment.

Nevertheless, caution must be used in the endeavour to employ artillery as early as possible. It would be wrong to send it forward on the field of battle without sufficient escort, and so expose it to surprises while deploying; or by advancing it too hastily into isolated positions, untenable against hostile skirmishers, necessitate an expenditure of power which would not correspond to the attainable success.

Reconnoitring—preferable by cavalry—and investigation of the enemy's position, must precede the efficient fire of artillery. The more searching the former, the more effective will be the latter. Mistakes, especially with respect to the front and extent of the hostile position, necessitate changes of front, which paralyze the fire, and can be executed only with great loss, especially when the artillery line is extensive.

Major Hoffbauer makes the following remarks on the employment of cavalry:—"The opening of a future campaign will probably see many cavalry engagements. That this was not the case in the Franco-German war is explained by the fact that one only of the opponents had a just view concerning the employment of his cavalry at the commencement of operations. The functions of cavalry will then be,—to discover the movements of the hostile army; to veil those of its own; to protect its country's frontiers; to seize and hold important posts, far in front, in order to gain time for the concentration of the army, and for its strategic advance; to cover important communications, railways, and magazines; to make raids against the enemy's communications, and diversions against his flanks.

"In order that cavalry may be properly supported by artillery, three horse artillery batteries are assigned to each Division, while a detached brigade should be accompanied by one battery."

Several reasons are given by Major Hoffbauer (p. 58) why artillery should advance to short ranges:—"The more open formation of the infantry attack.—*Moral effect.* This cannot be over-estimated. Advancing infantry derives new inspiration when the guns pass close by in eager advance, and their opening fire is heard; while the artillery is impelled by anxiety to support its comrades of the infantry. With what a welcome were the gunners received at such moments in the last campaign! Remember only the crowning of the 'Red Hill' in the battle of Spicheran by two batteries (3rd Light and 3rd Heavy) of the Third Corps; the advance of the 1st battery of the 1st division of the First Corps at Borny across the defile of La Planchette; that of the battery of the advanced guard of the 5th Division in the battle of Mars la Tour; and the timely support afforded by the 3rd Heavy Battery and a division of the 4th Heavy Battery of the 11th regiment on the Floing hill at Sedan.

"The advantage of being near at hand, to support the attack if checked, or to prepare the way for renewed efforts.

"The great advantage of close connexion with the infantry, so that the artillery can co-operate at the right moment, which is always difficult when the positions are too far to the rear.

"The decreased liability of being masked by advancing infantry. Moreover, the guns are far more likely to be able to co-operate up to the last moment, before the actual assault, without hazard to the other

troops. For at the decisive moment, smoke, unfavourable or misty weather, the sun shining in the eyes, dust flying about, approach of evening, and similar causes, very frequently render it impossible for artillery, posted far in rear, to distinguish friend from foe, and consequently it may, perhaps, cease fire at a critical moment, just when the enemy is bringing up fresh batteries, and hurls intact masses of infantry against the shaken assailants. As instances, we have the left of the French position at Point du Jour and Moscou in the battle of Gravelotte; and that of Mont Valérien at Paris on the 19th February, 1871, especially in the attack of the Montretout entrenchment, where, however, no blame can attach to the artillery. After the batteries of the Fifth Corps had cannonaded the enemy on the heights of Garches and the entrenchment, the infantry advanced to assault the latter, but the guns were prevented from going forward by the close and broken ground, and obliged to remain 2,000 paces from the entrenchment. They were ordered to cease firing because it was no longer possible to distinguish friend from foe, even with field-glasses. Immediately French infantry masses rushed from their cover against the Prussian infantry, whose attack, made moreover with insufficient numbers, failed. The artillery contest was resumed, and after darkness had begun, the entrenchment of Montretout again fell into Prussian hands.

"The possibility of artillery, accompanied by infantry, advancing under a heavy musketry fire at a range of 1,000 paces or less (as was frequently proved during the last war), and even of remaining under it in most instances. At Weissenburg three batteries of the 5th regiment advanced to within from 500 to 800 paces against the Geissberg Castle, occupied by the French; and one battery even executed a short but exposed flank march at that distance, in column of route. Not a single gun was silenced or rendered immobile, even for a moment; but the whole remained in action until the capitulation."

"In the battle of Wörth the two H. A. batteries of the Corps Artillery of the 11th Army Corps came into action 900 paces from Elsasshausen, opening fire on that place and on retiring columns, and received no material injury. One of them, the 1st, afterwards advanced to within 800 paces of the hostile infantry, when the Germans were actually falling back, and opened with common shell. The enemy continued to advance until stopped by case shot and by infantry, brought up to support the battery. The other battery, 3rd H. A., finally advanced beyond the skirmishers to within 800 paces of Fröschweiler, which was strongly occupied with artillery and infantry posted near it. Although its mobility was somewhat impaired, the battery was able to remain in action, and cleared the way for the infantry to Fröschweiler.

"At Spicheren the batteries of the Third Corps above mentioned advanced up the 'Red Hill,' and came into action 800 paces from a commanding position, strengthened with shelter-trenches, where they engaged three French batteries. This cost the batteries half their strength, but they, however, kept their position and gained their object;—that of securing a firm vantage-ground for their infantry.

"In the battle of Borny, batteries of the 1st Division took up

positions east and west of the gully of La Planchette, from 800 to 900 paces from French skirmishers, maintaining a hot contest of several hours' duration with artillery and infantry, and remained throughout in an efficient condition; but, nevertheless, some of them occasionally could only be moved with difficulty. At Mars la Tour the shortest ranges, as far as regards *offensive* action, varied from 800 to 1,200 paces. In attacking the important hill immediately north of Vionville, the battery of the advanced guard of the 5th Division advanced, covered by infantry, to 800—1,000 paces from French infantry, who essayed a counter attack. Three guns were left behind disabled, but came up later; the remaining three, with common shell, drove back the hostile skirmishers in disorder.

"At Gravelotte the shortest ranges were similar. It is notorious that of the four batteries of the 7th Corps, which crossed the defile of Gravelotte under circumstances of such exceeding difficulty, in order to join the contest at St. Hubert, one never came into action at all; another was able to get off a few rounds only; while the third maintained its fire for a longer period, and the fourth with great gallantry to the end of the action. By the two latter great losses were sustained, one battery being disabled for either fighting or moving, which, however, was not the case with the others.

"At the Battle of Sedan, the 3rd 4-pounder Bavarian Battery advanced at two p.m., near Balan, to within 500 paces of the hostile infantry, where it remained for three-quarters of an hour in line with the 6th Bavarian Brigade, and preserved its powers of action and moving. In Bazeilles itself, after the failure of two assaults by a company of Bavarian Jägers against a large building, two 4-pounder guns were brought up, and fire being opened on it at 70 paces, it was evanesced by the enemy.

"In many of these" (and similar cases quoted in the text) "the artillery sustained enormous losses of men and horses. But German guns were never lost" (as far as Major Hoffbauer knows) "except when artillery had lost contact with infantry. But at decisive moments, too great importance should not be attached to artillery losses, nor even to the possibility of losing guns. Each arm is fighting, not solely on its own account, but as a means of attaining the highest object—victory."

Unity of control is essential to artillery on the battlefield; consequently, tactical connexion is to be broken only when required by the object or the ground. For example, in the attack, in order to outflank an important objective; or, in the defence, in order to utilize all advantages of ground and to meet flank attacks. Artillery is employed, as a rule, in detachments of from three to four batteries, or in a regiment of from six to nine batteries; exceptionally by single batteries. The effect is increased by a concentration of fire on a single object, while by disseminating fire or batteries it is diminished. The extended range of rifled guns renders such a concentration of fire possible, since not only batteries at short ranges, but those more distant, can aim at a common object.

In attack, masses of artillery can—especially if sufficient time is allowed them—crush the resistance of any given point, and, under some circumstances, enable the assailants to penetrate into the enemy's position without fighting; while, in defence, they prevent the possibility of such a result. In both cases their action may be so far decisive.

The earlier deployed artillery (as a rule, Division artillery¹) is supported in the attack by that of other Divisions, or by corps artillery, as soon as the opposing strength demands it; or when—the point to be attacked of the hostile position being known—the assault has to be prepared by an energetic fire of artillery. In defence, this support is usually reserved until the enemy's designs become clear.

"Massing artillery" (we quote from Hoffbauer) "is an economy of time and of costly human life. Not to employ it thus, when practicable, is to fail in an act of humanity due to the army, and to neglect a powerful means to the decisive end. The system has gained so much importance, and massed artillery become so self-reliant, that it forms the principal arm during many periods of the battle. Owing to its great advantages, *single* batteries will not be employed without real necessity, and Divisional artillery should act as far as possible united.

"This is true in all stages of the battle. The most favourable time for deploying the largest masses commences, alike for the attack and defence, as soon as the plans of the opponent are discovered. A smart artillery combat will, as a rule, occupy the next hours of the battle. It is essential that the whole of the artillery, however large the mass, be under one commander, as long as it is firing against the same objects.

"When batteries, divisions (of more than one battery), &c., from different infantry Divisions, corps, &c., find themselves accidentally on the same ground, or when the same object is cannonaded from various positions, the senior officer concerned always takes command of the whole. This would be the commander of the division, when more than one of his batteries is present; the officer commanding the regiment in the case of corps artillery; the brigadier, when Corps and Divisional artillery are in action together. The senior artillery officer in the army, or senior brigadier, commands if batteries of different corps are united.²

"The extent of artillery masses, frequently very large, renders it impracticable for the commander to exercise more than a general supervision. This is obvious when it is borne in mind that the space occupied is frequently one or two miles. In the battle of Wörth, on

¹ The word "Division" is here printed with a capital when it refers to a cavalry or infantry Division. We have also a division of two or more batteries, and also the division of the battery, *viz.*, two guns, &c.

² The organization of the artillery of a German corps is as follows:—A general commands a brigade of two regiments. One regiment comprises eight batteries for the divisional artillery—that is, a division of four batteries for each infantry Division; the other regiment comprises nine field batteries, and three horse artillery batteries which are attached to cavalry Divisions as required, or employed with the heavy batteries as corps artillery.

the left of the Sauer, the artillery of the 5th Army Corps extended a mile; at Mars la Tour the line between the Forest of Vionville and the Trouville copses was two miles long; that of the First Army in the battle of Gravelotte, stretched a mile on each side of the village, whilst the great arc of guns at the same battle, embracing S. Privat la Montagne, extended two-and-a-quarter miles. Consequently the different bodies of artillery should be kept together as much as possible. Should they be unavoidably broken up, the earliest opportunity is taken to re-unite them. Meanwhile, they must be considered as groups of batteries under a temporary command. From the earliest formation of an artillery mass, attention should be directed to the proposed course of the contest. If it can only be formed gradually, the first divisions take up no more space than is absolutely necessary, even at the cost of leaving unoccupied some of the best positions. To obviate crowding in the mass, larger intervals between divisions and batteries are desirable if the ground permits.

"An efficient control of the firing is of the utmost importance. The whole of the field to be cannonaded should be told off in sections to the brigades, regiments, divisions, &c., by lines parallel to the lines of fire, the limits of these sections being indicated by conspicuous objects on the ground. Measures are taken from the very first to concentrate a continued fire on every point which is already important or likely to become so later on.

"When engaging hostile artillery, care must be taken that every part of it is kept employed; but in all cases an overwhelming concentrated fire must be directed against some of the batteries with a view either to annihilate them or to prevent them from effecting a similar result. The superior officers, while keeping themselves acquainted with the course of events, must not unnecessarily leave their positions, which should be, if possible, in the centre of their commands, and should possess a good view of the artillery contest. Owing to the effect of the firing on the nerves, and especially as regards hearing, it is most essential that they observe to what extent their orders are executed."

The choice of object, we read in the Prussian "Entwurf," depends on the state of the battle. The fire, concentrated to the utmost, will be directed on one object, and pass to others in succession, as demanded by their importance. A battle commences usually with a duel of artillery, the first target of the assailants' guns being under all circumstances those of the enemy, whose fire must be weakened in order to render the infantry attack possible.

Short ranges (under 1750 yards as a rule), rapid fire and changes of position in concert with those of the infantry, are necessary for immediate preparation and support of the assault. For artillery at long ranges to support an infantry combat at close quarters is dangerous, owing to the scattering of shells as well as to the difficulty of distinguishing friend from foe. Artillery, therefore, must follow the advancing infantry, resting on the main line of attack, and hasten to secure possession of the conquered ground by strong batteries. Beaten

troops cannot be harassed by artillery fire at long ranges without risk of hitting the pursuers. The most effective method is generally to advance rapidly and occupy positions on the flanks of the line of retreat.

If the artillery of the defence finds itself wholly unequal to a duel with that of the attack, it endeavours, as far as practicable, to withdraw from the fire of the latter, and only resumes activity when the hostile infantry advances to the attack. On the other hand, if it is able to accept the duel (because its inferiority in numbers and power is but slight or counterbalanced by superior skill), the fire against the assailants' troops is preceded by a cannonade, since he cannot show his infantry at first, and must draw off the artillery fire from them.

Hoffbauer speaks of the opening of an engagement by artillery as follows:—"At the commencement of an attack the artillery contest is generally confined to that of the advanced guard, except when the situation of the enemy is fully known from the very beginning of the advance to the battle, or when on coming in contact with the enemy he is discovered in unfavourable circumstances, either tactical or strategical, and advantage thereof must be promptly taken. Then it is possible and essential to push forward masses of artillery to catch him unprepared and surprise him; the batteries of the advanced guard being rapidly reinforced by the artillery of the main body. The Cavalry Divisions will, as a rule, support artillery advanced in this manner, and under some circumstances it would be very desirable that infantry should accompany it in wagons. The frontal attack is generally combined with flank attacks against one or both wings.

"As soon as the artillery of the advanced guard has covered the deployment of that of the main body, it should advance with the object of taking part in the decisive artillery combat. It is not as a rule necessary to hold back strong reserves. The object at this period of the battle is the enemy's artillery. From the very commencement every opportunity should be taken to obtain the ranges of all other important points by trial shots, and all offensive attempts by the enemy are to be energetically repulsed by artillery fire. As soon as the hostile artillery is engaged along the whole line, some of the batteries concentrate their fire against advanced posts, which, having been shaken, are to be carried by infantry, as soon as possible. After the repulse of the enemy the artillery must move to the front for a shorter range. Towards the close of this period of the battle, points of support and strong places in the enemy's main position form the chief objects. The long duration of the battle demands a deliberate fire. If the interval preceding the decisive infantry attack is short, and the hostile artillery not yet silenced, a concentrated fire of shrapnel is directed on it to render it at least as harmless as possible.

"At the same time especial care should be paid to the protection of the batteries, and it is generally permitted to take the limbers and teams to the rear under cover beyond the regulated distance. Artificial cover for guns and detachments is thrown up during the intervals of firing. The supply of ammunition is completed from the 1st line of the ammunition columns. At all events the gun-limbers and the wagons of the 1st line of every battery must have their full complement.

"When the time comes for the Decisive Attack, it may be that under favourable circumstances the artillery fire has been so effective, that the infantry has merely to take possession of the hostile position instead of storming it. But generally the decisive blow must be given by infantry, which, however, should never be attempted, until the artillery has annihilated or effectually weakened the hostile batteries, and poured a concentrated fire on the occupied posts of the position.

"If the front infantry attack is continuous along the greater part of the field of battle, and it is intended to make a concentric and enveloping movement, there is no room for masses of artillery. So many batteries only are posted in the first line as may be possible without incommoding the infantry. The artillery is there only accessory. It is advisable to withdraw all the Divisional Batteries that can be employed elsewhere, and if the configuration of the ground permits, they are pushed forward to ravines, gullies and salient spurs, wherever they can open a diagonal and flanking fire with effect. A suitable range for the Second Main Position is 800 yards, modified however, as it frequently will be, by the configuration of the ground, and the positions of the opposing troops. From the moment when the enemy becomes aware of the attack on his flank, and at any rate shortly before the commencement of the decisive infantry onset, the artillery on the flanks must open fire, if it has not already done so.

"The firing ceases as soon as the infantry reaches its volley-fire position at close quarters, when it halts for some minutes.

"If the attack is checked or repulsed and firing cannot be maintained over the heads of the other troops, the infantry retires in rear of the artillery line, which accompanies, and has now to support it. If the guns can fire over the heads of the troops from a position in rear, the pursuit of the enemy may be checked and the infantry rallied. Together with the batteries not yet employed, artillery masses may be formed, and the Commander-in-Chief will then decide whether to renew the attack or retreat.

"After a section of the ground has been stormed, the artillery is launched forward in large masses to secure its possession, to pursue the enemy with its fire, and to prepare further attacks. It must not wait for higher authority, but take the initiative, and act in the spirit of the Commander-in-Chief's intentions. To avoid delay the Artillery Commanders ride to the front during the last rush, as soon as the advancing infantry masks the fire of the guns against the principal object of attack, to watch the progress of the fight and observe where their batteries can be employed with greatest advantage.

"If any want of order appears in the retreat, it frequently becomes the duty of the artillery to crush all remaining power of resistance the enemy possesses, by advancing to the closest quarters to overwhelm his supporting batteries, and at the same time, by shelling them at long ranges, create confusion among the now distant and shaken troops. For this purpose the guns are massed as much as possible, and escorted by cavalry, which is already prepared to commence the pursuit. Of the greatest importance is it to push the advantage against the enemy's flanks and rear, which is generally executed by

the Cavalry Divisions. It may be advisable, especially if these are not forthcoming, to send forward against the flanks the Divisional cavalry from the nearest troops in rear with a few batteries, preferably the horse batteries of the corps artillery. At most, a battery for a regiment of cavalry is sufficient. More batteries can only be detached against the flanks in the case of the artillery advancing in connection with infantry, by which it is then protected, so that the movements of the cavalry may again be more independent.

"The defender seeks compensation for his inferiority of force in the advantages of the ground. He is frequently ignorant whether he will be attacked in his selected position, or in what manner the attack will be executed. Hence the German rule that the "skeleton" of the position only is occupied at first; that is, a few eligible battery-positions and important points, while all remaining troops must be held in reserve, ready and near at hand. These battery positions should be such as to command effectively at long ranges roads and defiles by which the enemy may approach, and all points especially eligible for his first artillery positions; as well as to ensure the security of the most decisive points of the general position. Artillery now becomes the principal arm, and the positions of the infantry must conform to it.

"The whole of the ground in front should be completely swept, mainly from the flanks, the number of batteries depending on the importance of the different parts of the position. Defiles, spurs, terraces, and convex slopes generally require oblique or flanking positions, which should be so selected that they themselves cannot be taken in flank, while a heavy fire must be directed on all obstacles in front, which the enemy may have to cross. The batteries are covered as far as possible, so as to be concealed from the enemy; and this also enables them to engage his artillery with the greater success, and to meet the assaulting troops more suddenly and decisively. Gun-pits are used when necessary and practicable, especially in the skeleton position. They must always be hidden from the enemy's sight by either natural or artificial objects, as otherwise they are more injurious than useful. The batteries remain near them as long as possible, limbered up and withdrawn from view. It is, moreover, essential to shield guns in action from hostile skirmishing fire, and for that purpose lines of skirmishers are thrown forward 500 yards, and well extended to the flanks.

"As soon as the position is fully occupied in accordance with the information gained of the assailant's plans, a portion of the artillery is held in reserve to meet any unexpected movements, or to support a counter-attack. Knowledge of the ranges gives artillery on the defensive a great advantage, and it should therefore obtain those of all important points in front during the opening contests.

"Encounters between the cavalry pushed forward on both sides frequently form the prelude of the battle, when the action of the horse artillery will be guided by the rules given for it in the case of Cavalry Divisions. If the advanced guard (now the rear guard) becomes seriously engaged while covering the deployment of the main

body in a position in its rear, it is often necessary to support it by rapidly pushing guns to the front.

"During the interval before the decisive attack it is the duty of artillery in the main position to prevent all movement on the part of the enemy's advanced guard, and to impede the deployment of his artillery and main body, as well as to engage the assailing batteries with the utmost vigour, because on the result will often depend that of the battle. While the infantry is delivering its attack, and if the hostile batteries are still able to prosecute their fire, the defender must employ a portion of his guns to keep them in check. But as soon as he has silenced them—or, at latest, when the infantry has arrived within close rifle range—he directs all his fire on the latter. A victory gained over the attacking artillery is often decisive in thwarting the assault.

"Should the defending batteries, however, prove inferior, they, with the exception of those that have been withdrawn to positions in support, must under all circumstances co-operate with the infantry to the last in opposing the assault. Rifle fire is supplemented by shrapnel and case, while the fate of the infantry is shared by the artillery. At this period great advantage may be derived from having provided gun-pits at well-selected points, whence an oblique and enfilading fire, sweeping and flanking the slopes of the position, can be directed at very short ranges on the assaulting infantry. The defence does not preclude offensive action when the counter-attack should be prepared by a concentrated fire from as many guns as can be collected.

"If a retreat takes place, a portion of the artillery remains with the rearmost infantry, ultimately retiring at a walk; while another portion takes up positions in support on the flanks. A body of cavalry with its horse battery must be at hand to oppose any enveloping movements on the part of the hostile cavalry. The rearguard is strongly reinforced with artillery, which must be fully supplied with ammunition."

We find in the "Entwurf" these rules for horse artillery:—When cavalry deploys, and there is no danger of a surprise, horse artillery—whose proper position in the line of march is as near as possible to the head of the column—comes into action early, and with as many guns as there is space for, selecting a position beyond the reach of musketry, and at such a distance from the hostile cavalry that this may not be able to reach it before its own cavalry can come up. It is most advantageous if the guns of the Cavalry Division can maintain an effective fire up to the moment of assault from its first position; but if this is not possible it will have to advance in order to cannonade the object of attack. Flanking positions are preferable to those in front of the cavalry.

If several lines of cavalry come into collision, the artillery maintains its fire as long as possible, then limbers up ready, according to circumstances, to advance or to re-open fire from a position in rear, whence it checks the pursuing enemy as much as possible, while it affords time and opportunity to its own cavalry to re-form. If the

opponents are driven back, the artillery follows with the nearest troopers of the division which retain their formation, in order to prevent the enemy re-forming, and to open fire on any reserves that may be moving up.

As a rule, artillery of an independent Cavalry Division requires a special escort. That attached to an Infantry Division, and, still more so, every artillery line of any extent, is sufficiently protected by its own fire and by the troops on which it rests; and, since the fighting generally centres on the position of the artillery, that arm, if judiciously handled, is protected by its situation. Should the flanks of an artillery position be threatened, they must be protected by troops of the other arms, placed there for the purpose. An escort of infantry is generally posted on the flanks and in advance of the position; an escort of cavalry likewise on the flanks, but in rear. The ground decides in all cases. If attacked, the artillery maintains its fire as long as possible; and if on the flanks, the batteries wheel to meet it; if in rear, the guns are thrown round in action. Should the enemy penetrate into the battery, the men use their arms, the gunners getting between the wheels of the limbers.

On the subject of Horse Artillery attached to Divisions of Cavalry, Major Hoffbauer says:—"The Divisional Commander informs the officer commanding the horse artillery what is the general plan of operations; the flank or approximately the position where he is to come into action; and as soon as possible also the time likely to elapse previous to the attack. In default of direct orders, and if there is no time to seek them, the Artillery Commander carries out his superior's intentions as far as he can. General points to be attended to in every position are—to obtain, by massing his guns, the most powerful and lasting effect; to avoid hampering the cavalry when deploying or attacking; and to provide for the safety of the division by the support of the other troops and the natural advantages of the ground. As soon as the hostile artillery opens with effect on the advancing cavalry, if the latter is unable to obtain cover from the ground, the artillery must take up a position from which it can draw off the enemy's fire, and if the range proves too great, it will as soon as practicable move forward by echelon.

"The First Position is selected with a view to covering the advance into position of the main body, and to cannonading the hostile batteries, generally at a range of 1,200—1,500 yards. After getting the range accurately by common shell, it is most advantageous to use shrapnel. As soon as the cavalry commences the movement, preliminary to its deployment for the attack, the artillery with its guns loaded advances at a galop to the Second Position in order to prepare the attack at close and most effective ranges. This movement is made in echelon, two batteries going forward at first, the third advancing with them only in the case of its being necessary to silence the hostile artillery; otherwise it maintains a rapid fire until the others come into action. In this position the artillery is as a rule 800 yards from the hostile infantry, and 700 from the cavalry; but should the latter advance to

meet it, it must halt at not less than 250 yards from the probable line of collision. If the enemy is driven back, the artillery follows its cavalry with the utmost rapidity and takes up a good position, whence it may improve the advantage already gained, so far as this may be practicable without detriment to the pursuing cavalry; and also to make it impossible for the dispersed enemy to reassemble, as well as to oppose his fresh reserves as they come up.

"Should the attack be unsuccessful, well posted artillery, provided it is not involved in the consequent disorder, may often form a firm pivot for the cavalry to retire on, at the same time checking the enemy's fire and the pursuit of his cavalry. It may even succeed in restoring the battle.

"If the Cavalry Division is acting on the defensive with a view to gain time, it will prefer ground with obstacles in front, enabling it to withdraw from the fight if required to do so. Expected flank attacks are to be met by strong reserves, and by taking up positions of support.

"Artillery is here the principal arm, and the cavalry must conform to its movements. It should be supported by dismounted troopers, who will make short counter attacks as opportunity offers. Owing to the difficulty of supplying ammunition during these operations, horse artillery must be careful not to waste it by a useless fire at unimportant periods."

Changes of artillery position are rendered necessary by the course of the combat. But if frequent they are detrimental to effect, and if of a few hundred yards only, are therefore to be avoided, unless indeed it is desirable to make a short movement to the front or rear in consequence of the opponent having got the range accurately, and so mislead him or force him to obtain it afresh. A single battery generally moves in this case entire, but if there are several, they move in echelon, taking advantage of the ground. The same holds good if the batteries, although separated, are working for the same end. Movements to the front are made at a rapid pace; (trot, galop, and occasionally by horse artillery at the charge): those to the rear are as a rule made at a walk, and at a quicker pace only when the object is to escape evident danger or to unmask positions in rear.

When a battery ceases fire from want of ammunition it remains under the hostile fire while a supply is being obtained. Even silent batteries are not without their effect, for the enemy is ignorant of the cause, and whether they will not reopen at the decisive moment. A battery in action is not generally withdrawn, but supported by the advance of others. Great loss even is not a sufficient reason for ceasing fire and retiring.

"On the contrary," says Hoffbauer, "the position should only be abandoned by order of the officer commanding the body of troops to which the batteries belong. There are circumstances when it becomes the duty of artillery to sacrifice itself in order to gain time for the other arms. This may extend even to the loss of guns. Under such circumstances the Austrian artillery at Königsgrätz devoted itself to save the army, and its conduct merits the highest recognition."

Major Hoffbauer considers that "a greater fault than a too frequent change of position is to lose connection with the troops advancing in front, by remaining too long in rear. Batteries change position in echelon, as above stated, in order that the enemy may not for a moment be able to prosecute the fire undisturbed, and if he can direct an effective fire on our infantry and cavalry when without cover, the rule is all the more important. Even to the rule that a single battery is to move entire, there must be exceptions, as when the disadvantage of dividing it is subordinate to that of permitting the enemy to continue his fire undisturbed."

Rendezvous Position.

Artillery is here placed on the flanks or rear of other troops; a single battery with its guns at full or half intervals; a division in close column of batteries.

The Commander of the Artillery.

He accompanies the Commander-in-Chief of the army in his reconnaissance, in order to receive his orders. As soon as fighting commences, he personally assumes command of his own arm. During the course of the battle the Commander-in-Chief keeps him acquainted with his intentions, and furnishes him with orders. "In order to learn these," says Hoffbauer, "it may be necessary for the Artillery Commander to leave his own troops temporarily, even after the battle has commenced. He obtains information during the combat respecting the ground in front and rear, and takes precautions, as far as possible, against any impediments to future movements. In order to insure a timely supply, he watches over his communication towards the rear, and gives a sufficient warning of a contemplated movement in that direction to the second line of wagons. Should the course of the contest be favourable, he selects fresh positions, riding to them in advance to reconnoitre. In the event of retiring, he remains with the guns and sends back officers to reconnoitre supporting positions."

Choice of Positions.

Every position should be reconnoitred beforehand by the Commander, and should always be selected with an eye to efficiency of fire rather than to cover. The main consideration is an extended and open range, such that the ground can be swept at the shortest distances. Other desirable conditions are, sufficient space, a level surface, wide command, and that the position be perpendicular to the line of fire, and not too irregular in its general outline. The most favourable position is behind the crest of ridges or undulations, which slope gently towards the enemy; or else in rear of low eminences, hedges, and such like. Stone walls are to be avoided. But it is not advantageous to post guns *immediately* behind such cover or close to conspicuous objects, as they facilitate the enemy's aim. High eminences are more suitable as places of observation, than as positions. As a protection to the guns, soft or broken ground immediately in their front or flanks is advantageous, provided that mobility is not thereby compromised.

Cover in rear for the limbers and first line of wagons is equally desirable. The edges of woods or villages behind guns form a background against which they show distinctly, facilitating the enemy's fire and observation of its effect. If there is time, it is recommended to entrench guns not otherwise covered.

Although a caution is here given against placing guns behind a stone wall when exposed to artillery fire, such a protection may be very valuable from musketry, as proved by the case of the garden wall of the farm of St. Hubert at Gravelotte, which, but a couple of feet in height, effectually protected a battery of the 7th brigade. As instances of the danger to be apprehended from the immediate proximity of conspicuous objects, Hoffbauer gives the following:—

“The 3rd light battery of the 10th regiment in the battle of Mars la Tour obtained the range of some hostile artillery, whose position was difficult to discover, by firing on a house close by it. In the battle of Blumenau 1866, the heavy losses sustained by a battery of reserve artillery were accounted for by the conspicuous object presented by two white stones between which it was posted.

“Far better than the direct protection afforded by cover, which can be seen by the enemy, is, according to the experiences of the last campaign, a formation of ground which perplexes his aim. This occurs when banks, houses, trees, bushes, hedges, cornfields, &c., forming masks between the contending artilleries, are so situated that our own can see far over them. In such a case the hostile artillery cannot observe when their shells burst short.

“In the battle of Gravelotte some of the batteries of the First Army were so placed that they could see directly over the tops of the trees in the defile of la Mance. It was therefore very difficult for the hostile artillery to hit them, as it was hardly possible for it to observe that its shells burst too short.”

Major Hoffbauer calls attention to the importance of the artillery in the Main Position bringing its duel with the hostile guns to a close previous to the deployment of the main body; driving the enemy back from his advanced posts, and shaking adequately whatever may be the principal object of attack. The advanced guard takes up its position sufficiently to the front to allow of its guns engaging at moderate ranges of from 1,400 to 2,000 yards. Diagonal and flanking fire is effective at more than 3,000 yards. In an extended line of battle, moreover, no portion of the artillery ought ever to cease firing altogether, on account of the range being great, but maintain a deliberate fire, so as to keep the enemy's guns in check, and prevent him enfilading effectually other parts of the position.

“From the reconnoitring engagement of the advanced guard a decision as to the main attack is arrived at. The Commander-in-Chief, as soon as possible, instructs the Divisional Commander, &c., as to the proposed attack, and gives distinct orders regarding the employment of the artillery. The officer commanding the latter should be informed where the main body will deploy, and the time it will take to do so; and also when and where the decisive infantry attack will take place. If no further orders reach him, and there is no

equally
a back-
my's fire
mended
behind a
may be
garden
ouple of
le. As
te pro-
f Mars
on was
battle
reserve
ed by
eli can
e last
This
&c.,
l that
illery
Army
trees
' the
serve
llery
to a
the
hat-
guard
rums
onal
ded
ease
ent
ard
inc.,
he
er
it
ry
no

time for enquiry, the Commander of the artillery must act in the spirit of the general intentions of the Divisional Commander, &c.

"During the first period of the attack, the artillery of the main body is placed—as far as permitted by the configuration of the ground, the position of the object, and the general form of the attack—on one of the flanks, with cavalry or a small detachment of infantry beyond it; preferably on the pivot flank if a change of front is anticipated. It will secure and cover the deployment of the main body.

"During this operation, and previous to the decisive attack of infantry, the artillery must direct its fire, not merely against the hostile batteries, but also against the principal object of attack. Therefore, the whole of the artillery of the main body is brought up to co-operate with that of the advanced guard. The range will generally be from 1,400 to 2,000 yards." (The extreme range at which the German field artillery gun can be depended on to make 20 per cent. of hits against guns, exclusive of limbers, is 2,200 yards.)

"From its First Main Position the artillery prepares the attack of infantry, checking the fire of the opposing batteries by shrapnel, as soon as the range is obtained. The attack of the infantry ensues, the artillery always moving to more advanced positions in support, although it may be possible to continue the fire from positions more to the rear.

"The Second Main Position must, as a rule, be so far advanced that everything that may oppose the rush of the infantry on the decisive point, can be cannonaded until the latter reaches its volley-firing position at close quarters. A suitable range will be 760 yards.

"The advance from the First to the Second Main Position will be made rapidly in echelon, and will commence as soon as the front line of troops approaches the guns. They must cease firing against the object of attack as soon as this becomes dangerous to the attacking infantry, when they will aim at hostile batteries and any reserves that may be visible. They will also be ready to repulse flank attacks, which may now be looked for.

"If the assault is successful, the artillery receives orders from its Commander, who has followed the decisive infantry attack, to advance immediately, in order to secure possession of the conquered position, and to be ready for pursuit. Should it miscarry, the artillery in its last position supports the retiring infantry, its further movements depending on the plans of the Commander-in-Chief.

"Ideal positions, fulfilling all requirements, are, however, seldom to be found. The defender has more time at his command to discover the best positions for his guns, while the attacking Commander has to decide after hasty reconnaissance; otherwise, while seeking them, he may let the right moment pass. But above all things, the general object of the battle must never be lost sight of.

"Pauses are of frequent occurrence in artillery fire, as during the battles of Mars la Tour, Wörth, Gravelotte, &c., and advantage should be taken of them to throw up artificial cover, especially when the detachments are long exposed to musketry fire. The leader of the

first line of wagons receives orders from the battery Commander as to its position, which should be from 50 to 100 paces in rear of, and beyond the less exposed flank of the battery.

"The leader of the second line of wagons must use every exertion to bring them up to a distance of 800 yards from the batteries. Frequently during the battles of the late war, failure on this point caused a deficiency in the supply of ammunition; and yet there is abundance of proof that artillery, even in its first positions, must have recourse to its second line of wagons. The second line of the battery obtains its supply from the first line of the ammunition column, the latter, when empty, being relieved by the second line. But this regular order of supply had frequently to be disregarded in the late campaign.

"Artillery opens fire as suddenly as possible, and with all its available guns; in exceptional circumstances only, with a few guns. Inopportune and too rapid fire is a mere waste of ammunition, which cannot always be immediately made good. Rapid firing should be accurate and well aimed."

The March to the Position.

For long distances all practicable roads must be used by artillery, as far as possible, either in column of route or divisions, according to their width. Across open fields it marches generally with full intervals, the breadth of front depending on the ground and formation of the other troops. In close country, as the front must frequently be decreased to allow of passing obstacles, column of route becomes the most advantageous. Columns of batteries can conform well to the undulations of ground, and change their direction with facility. Columns of divisions with close intervals are convenient for flank movements, being of slight depth and easily handled. Batteries or divisions (of two or more batteries) deploy if possible beyond the enemy's range, behind cover, or masked by other troops. When deployed they advance directly towards the enemy to their position. Once within range, all oblique movements or exposure of flanks to hostile fire are to be avoided. It depends on the formation of the ground, the nature of the soil, and the situation of the enemy, whether the batteries on reaching their position, unlimber at once, or reverse and then unlimber, or whether they unlimber in rear of the position and run the guns to the front. The prescribed intervals of 20 paces may be disregarded, nor is it of importance if the guns are a few paces in front or rear of the alignment; but the intervals should not be less than 10 paces or greater than 40, as the former facilitate the enemy's aim, and the latter render it impossible to supervise the battery.

Hoffbauer considers that column of route has an advantage over column of divisions under certain circumstances, especially in the case of single batteries. "It was by far most generally employed in the late war, for movements to the front as well as for diagonal and flank movements, as at Wörth, Borny, Mars-la-Tour, and Vionville, &c. The artillery of the Fifth Corps always deployed from this formation, which is accounted for by the configuration of the battlefields, being

generally very close and intersected by streams, ditches, gullies, and such like, so that movements were limited in many places exclusively to the roads and bridges. At the Battle of Gravelotte alone every kind of formation was used. Column of divisions with close intervals was used for flank movements by the Horse Artillery division of the 3rd Regiment at Verneville, and by the 2nd Field division of the 7th Regiment south of Gravelotte. The 1st Field division of the 10th Regiment made a flank march southwards in close column of batteries from St. Privat la Montagne covered by high ground, in order that its batteries might wheel to the left and come into action successively wherever there was sufficient space between other German batteries already in action."

"The simplest mode of deployment is to take up an alignment with the head of the column. This was most generally adopted in the last war, and almost exclusively so by the Fifth Corps. Coming into action simultaneously, instead of in succession, possesses the advantage of simplicity, and of affording a less favorable mark for the enemy's guns; but the latter may be expedient if it is a question of opening fire at once, after debouching from a defile in column of route or division. The 1st Horse Artillery battery of the 11th Regiment in the Battle of Wörth, coming up to the east of Elsasshausen, and having to open fire immediately at a critical moment, brought its guns into action in succession. And at Gravelotte the 2nd Field division of the 7th Regiment marched in column of route at a trot along the road towards the previously reconnoitred position south of that village, until it cleared the forest, where column of divisions was formed in succession. Then by a flank movement, on ground where cover was obtained both from the fire and sight of the enemy, the whole division was able to form front to the right.

"Wherever several batteries have to deploy under hostile fire and march up in succession, fire must always be opened by batteries as soon as they come up, in order to check the enemy's fire and divert it from the batteries in rear while manœuvring and forming up."

Observation of Aim.

Observation of the bursts is necessary for effective fire, without which a close adhesion to the rules will not produce the desired result. Constant practice, therefore, is of great value, as external conditions, clearness of atmosphere, weather, distance, and background, as well as the nature of the object and of the ground, materially affect the observation, and in warfare cover and smoke frequently obstruct it. All that can be relied on is the fact whether the shells are bursting mostly behind or in front of the target. Experience teaches that the observation of actual strikes leads to great errors; and is only exceptionally reliable, as for instance, at very short ranges, or where the effect is distinctly shown by confusion at the object, exploding limbers, or other unmistakable evidence. Even when firing against objects on steep slopes or behind earthworks, it is often possible to distinguish whether the strike is on the near or reverse slope. It is then also sometimes exceptionally possible to judge the amount of deviation of shells when

bursting too short, although this is rarely the case; but never so, when they are bursting too long. In circumstances which make observation peculiarly difficult, as when several batteries are firing on the same object and it is consequently difficult to distinguish to what batteries the projectiles belong, a battery may find it expedient to fire a salvo, and so obtain more certain information.

Choice of Projectile.

Common shell is suitable against all objects of the battlefield, especially for direct impact, and effects its purpose by its percussive power as well as by its fragments. But it is so far dependent on the nature of the soil that soft, boggy ground, or water immediately in front of the object, diminishes the effect, which a firmer soil augments.

Shrapnel, bursting in the air, owes its effect to the force of its fragments and bullets. This, however, being comparatively slight, shrapnel should be employed against living objects only. It is so far independent of the soil that it ought to burst in the air; consequently it is peculiarly advantageous against objects under cover, and in this way supplements common shell. At ranges under 400 yards it can be used without further preparation instead of case shot. The latter are employed in defence against attacks with the bayonet.

"Common shell," says Hoffbauer, "is adapted for every purpose, and more particularly where shrapnel is not suitable. Shrapnel is effective against all living objects up to a range of 2,750 yards, except when protected by walls, banks, and similar obstacles, especially so against moving objects having to pass certain points of ground of which the range is known. It is advantageous before using shrapnel to obtain the range by means of common shell.

"Common shell is employed exclusively at ranges over 2,750 yards, and moreover against all inanimate objects, such as gates, bridges, walls, and villages. Shrapnel is especially advantageous at suitable ranges against large motionless bodies of troops, against recumbent skirmishers, against a foe concealed in the undulations of the ground, against artillery in a prolonged contest, especially if enfilading it or when plantations are likely to cause premature bursts, and also against the interior of field works. According to the experience of the last campaign, guns are rarely dismounted by common shell, and much time is necessary for the purpose. When after a long and perfectly successful duel of artillery the most important of the enemy's batteries are silenced, at least for a time, so that the decisive attack of infantry ensues, then shrapnel will be effective.

"Common shell gave complete satisfaction in the last war. The greater part of the German artillery being unprovided with shrapnel, it was but little employed. Two instances are recorded when its effect was very good—at Paris, on the 19th January, 1871, and at Belfort. But having been brought to great perfection since the last war, shrapnel has apparently a great future before it, since confidence in its effect and skill in its use has materially increased in the last few years.

"Case shot is employed in defence against sudden attacks at

ranges up to 440 yards. In the last war 281 case shot were expended by the Prussians, most of them at Wörth, where 64 were fired by four batteries of the 11th Regiment. Both Wörth and Sedan afford instances of the invariably successful repulse of formidable cavalry attacks by case shot from batteries of the 11th Regiment. The cavalry always retired in confusion, while at Sedan only a few troopers succeeded in penetrating batteries in action. In other instances case was employed against infantry, generally skirmishers, and proved extremely effective whenever the range was not too great. Some instances occurred when the effect was doubtful, and it is known that at a sortie from Paris in September, 1870, a battery failed in repulsing the enemy with case shot at 500 paces, which, however, was effected with common shell at 450 paces. Common shell frequently answered the purpose of case shot within case shot ranges most thoroughly, as for example, when the 2nd Heavy Battery was moving with Wedell's Brigade at the battle of Mars-la-Tour. The gist of the matter appears to lie in possessing presence of mind at such critical moments.

"In the action of 4th January, 1871, at Rouen, we have an exceptional instance of a battery of the 1st Regiment acting on the offensive against skirmishers at from 300 to 400 paces, and driving them back with four case shot, which were immediately followed by common shell. The battery had found itself at these close quarters owing to a dense fog, and was for the moment completely taken by surprise.

"With regard to carcasses, employed by the Bavarian artillery on some occasions, recent accounts are not favourable."

Fire-discipline.

This must be attained by good instruction, and should exclude all errors and misconception with respect to choice of projectile, object and aim, range and order of fire. The officer controlling the fire remains on horse-back, posting himself, as a rule, on a flank of the battery, and until the range is obtained, leaves it only under exceptional circumstances, when he must be careful to keep within such a distance that his orders can be distinctly heard. In firing to obtain the range it is essential that the object be clearly indicated, and all the guns laid on it, but as this can hardly be attained by a short order, it is advisable that the battery Commander should in all cases at all doubtful direct an Officer or N. C. Officer at each gun to verify the aim. Whenever the order designates a particular flank of the enemy's position as the object, it must be understood as referring to the flank so called by the enemy, *e.g.*, the left flank of a line of skirmishers would be the right flank looking from the battery; similarly the fourth gun would be that called so by the enemy, numbering from his right.

Control of Fire.

This embraces the order and rapidity of fire, and the mode of aiming at certain objects according to the nature of ground, as well as concentration or dissemination of fire.

A single Battery.

The order of firing is, as a rule, by guns in succession from a flank, and is adhered to even in rapid firing, except with volleys or case shot. Rapidity of fire depends on the possibility of observation and progress of the battle; if excessive, it may lead to very bad results while obtaining the range, and must not be allowed to compromise accuracy in correcting the aim; but as soon as the range is discovered, the rate may be accelerated. Under ordinary circumstances, with a battery of six guns, the average interval between the rounds is from 15 to 20 seconds, which may be prolonged in detaining combats, or when ammunition runs short. The firing must be rapid, at the decisive moment, at close quarters, or when momentary advantages are to be secured. Experience teaches that in such cases a round can be fired in 6 or 8 seconds.

In warfare it is one of the most important duties of the battery Commander to obtain the range, and even after this is effected the control of the fire rests, as a rule, in his hands. When a battery has to take up a position under circumstances of difficulty, as, for example, under a heavy musketry fire, or under a superior fire of artillery, it is advisable whenever practicable to load the guns, adjust the tangent scale, and indicate the object, before coming into action. While obtaining the range, the shell fire should generally be directed at a single point of the object.

Artillery firing against artillery will obtain the best effect by laying on a central gun, if all are equally visible, otherwise on that one which is most conspicuous. If the wind is across the range, the fire should be directed at the gun on the flank from which the wind is blowing. Against masses of infantry the centre of their first line should be selected as the object, and if infantry is in loose formation, the centre of its skirmishing line. In cannonading field-works and extensive shelter-trenches, the fire may be disseminated over the whole of the object, even while obtaining the range, as observation in such cases is easy. Shrapnel fire is, as a rule, preceded by common shell, and can be spread over the whole object from the very first, especially when directed against artillery or skirmishers.

Concentration or dissemination of fire depends on the principle that the former is necessary in order to obtain the greatest effect from common shell, while shrapnel allows of dissemination. After the range is determined, a dissemination of fire with common shell is admissible only when several guns can maintain an overwhelming fire on a portion of the object. In the case of a single battery cross-fire presents no advantage.

A Division of several Batteries.

If several batteries are united under one Commander, he names the kind of projectile as well as the object of fire, either for each battery separately, or for the whole. The mode of issuing the orders depends on the state of affairs, whether it be possible to give them verbally or by bugle, or whether the Divisional Commander can give them personally

to the Officers commanding batteries, or send them by his adjutant, &c. When several batteries open fire simultaneously on the same object, they obtain their range and fire by batteries. The Commander of the Division points out to them the section of the general object on which each is to lay its guns, and by a general comparison of the ranges obtained by them severally, he is enabled to judge whether the operation has been accurately executed.

In some, but quite exceptional, cases, the Commander of the Division can take the personal control of the fire, and then direct one of the batteries to obtain the range, or the whole division, commencing at a flank. As soon, however, as this is accomplished the order of fire proceeds by batteries. Whenever artillery is engaged, and other batteries come into action against the same object, the latter take the range that has already been found correct, thus saving time.

It is equally a maxim that every available moment should be used in offensive, and still more so in defensive warfare, to determine the ranges of certain objects on the ground, and so ascertain the distances in front, which may become important during the battle. All firing over troops is to be avoided as much as possible, and on no account should this take place when there is any difficulty in distinguishing friend from foe.

On this subject Hoffbauer remarks: "When firing over troops in front is possible, it is generally also required by the state of affairs, and almost all the battles of the last war give instances of successful firing over other troops without danger to them. In some, however, firing was ordered to cease at the wrong moment, which allowed the enemy to bring an overwhelming force against the infantry. On the other hand, where the firing was continued *too long*, some casualties occurred to parties of infantry, who, not waiting for the orders for the general attack, ran into the artillery fire, which had not then ceased. Nevertheless, it is probable that had the guns ceased firing sooner, still more numerous casualties would have been occasioned by the hostile infantry. When the artillery did not cease firing at the right moment, this was owing to the formation of the ground and bad light, which prevented it from observing accurately the progress of the infantry, so that in one case this range was estimated too high, in the other too low.

"To the question, how a cessation of fire is to be brought about at the right time," Major Hoffbauer replies, "only by due communication from the front, for which purpose preconcerted signals are often preferable to mounted orderlies."

In an appendix to the "Entwurf" are the regulations for the Supply of Ammunition in the Field.

Distribution of a Battery.

1. On the march.—The wagons form part of the battery. Each of the first six ammunition wagons follows the gun bearing the same number. Then come the other two ammunition wagons, store-wagon No. 1, forge-wagon and store-wagons Nos. 2 and 3.

2. In proximity to the enemy.—On commencing a march in the

neighbourhood of the enemy, and when an engagement may be expected, at the order "Form echelons," the wagons are formed in two echelons. The 1st consists generally of four ammunition wagons and store-wagon No. 1; the second of the remaining ammunition wagons, the forge and store wagons 2 and 3. The commanding officer (of the Army Corps, Infantry Division, &c.) can order a different distribution, if considered desirable. The 1st echelon is commanded by an Officer, if available; if not, by a non-commissioned Officer; and follows immediately the guns of the battery, both on the march and in battle. Allotted to it, and drawn from the battery reserve by the Officer commanding the battery, are—two non-commissioned Officers, one surgeon (if one is present with the battery), one hospital assistant, four bearers of the wounded, two spare drivers with four horses, Nos. 6 of the gun detachments, and as many gunners as will make up six to each wagon when all are mounted.

With a battery of horse artillery there are 10 spare gunners, who also hold the horses of the hospital assistant and bearers when obliged to dismount for service. No. 1 store wagon carries two bearers.

The 2nd echelon of each battery is commanded by the *capitaine d'armes* (*quarter-master*), and attached to it are the spare horses and the battery reserve. The 2nd echelons of the batteries of a division are united in rear of the column, and commanded by a senior Officer nominated by the Commander of the Division. Their position is immediately in rear of the Infantry Division to which they belong.

When batteries are allotted to advanced guards, rear-guards, or other detachments, their 2nd echelons follow in the rear, the necessary distribution being published in orders by the Officer commanding the detachment.

Position of the First Echelon.

When the battery advances, the 1st echelon accompanies it closely until it reaches its first fighting position. The halting place of the echelon is selected by the Officer or non-commissioned Officer in command, who receives or asks for fuller instructions from the Commander of the battery, depending in each case on local conditions and the state of affairs. Easy communication with the battery, and freedom of movement to the front and rear, must be secured as far as possible, and cover from the enemy's fire regarded as a secondary consideration; while, at the same time, the movements of other troops must not be hampered.

The form of the ground will here be of great importance, and, still more so, an accurate estimate of the enemy's fire. It would generally be sufficient to draw up the wagons at a short distance (50 or 100 paces) beyond, and in rear of the less exposed flank of the battery, with sufficient intervals between them to allow of their reversing. A slight curtain, as a row of trees or of bushes, or even a moderate undulation of ground, will conceal the wagons from the enemy's view. To place them in rear of the battery is dangerous, but often unavoidable; nor should they, as a rule, be placed on the roads, but at the side

of them, and whenever time permits convenient access to the roads should be prepared. Exceptions to this rule are when mountain defiles, embankments, or long roads through thick forest, make any deviation from the roads impracticable. Under such circumstances the wagons must do their utmost to keep to the sides of them.

If the battery takes up a position in front of a defile, the Commanding Officer decides whether the 1st echelon will cross it or not, taking into consideration the state of affairs, the character of the defile, and other local conditions. As soon as a situation has been selected for the wagons, their leader reconnoitres the ground in front and rear, and sends the more important information as to the ground, its configuration and its suitability for manœuvre, to the Officer commanding the battery, to facilitate the future movements of his guns. Especial attention must be paid to the communication in rear, if there are obstacles or impassable ground in that direction.

Connection of the First Echelon with the Guns.

To ensure a prompt service on all occasions, the Commander of the wagons must communicate personally with the battery, as often as possible, in order to keep himself informed as to its requirements, and the movements it is about to execute, which should never be hampered by the wagons.

When the battery advances or moves to a flank, the 1st echelon follows it at the same pace, and should not be separated from it by any impassable ground that may happen to lie between them. In such cases the wagons should rather decrease than increase their distance from the guns.

If the battery limbers up to retire, the wagons reverse and precede it, and in the event of a flank movement that route is followed, which has previously been selected as the most convenient. The pace depends on that of the battery; defiles presenting no difficulties, are passed at a trot; otherwise, at a walk, so as to avoid accidents to the wagons, which might result in a block.

Supply of a Battery by the First Echelon.

When the battery has opened fire, the Officer in command takes advantage of every favourable moment (pauses in firing) to supply it; and this must never be delayed when the expenditure has reached half the number of shells in the gun-limiters. The complement of case shot should invariably be maintained. If the required supply is not very small, two ammunition wagons are sent forward from the 1st echelon with their gunners; they reverse in rear of the 2nd and 5th guns, and halt 10 paces from the gun leaders or horses of the detachments. All the gun-limiters are filled. But this method is difficult in prolonged combats, when it is preferable to expend the ammunition taken direct from the wagons.

Removal of Empty Wagons from the First to the Second Echelon.

Whenever a supply has been made to the battery, the Commander of the 1st echelon should ascertain if it is possible to empty one or two

wagons completely. If so, they are sent immediately at a trot under a non-commissioned officer to the 2nd echelon and exchanged for full wagons, which are brought up to the 1st echelon by the same non-commissioned officer, and at the same pace. If, meanwhile, the 1st echelon has changed its position, the Commander must take the steps necessary for the wagons to rejoin it, and leave men for that purpose, if necessary. If a movement towards the rear is made, the non-commissioned officer in charge of the wagons must be informed of it.

Supply of Men, Horses, and Material from the First Echelon.

In addition to ammunition, the losses of the battery in men, horses, and material is made good from the 1st echelon, and the complement in this echelon is invariably filled up as soon as possible from the 2nd.

Conduct of the First Echelons when several Batteries are united under one Officer.

When several batteries are in action under the same Commander, he has to give general directions for the wagons; as a rule, the supply is executed by the batteries, and these must consequently preserve their connection with the 1st echelons. The latter are now more exposed, and it may be necessary to place them in rear of their batteries. If a battery is withdrawn from the line, its echelons conform to its movements.

Conduct of the Second Echelon of a Single Battery.

The Commander of the 2nd echelon from his position in the column on the march, maintains communication with the Officer commanding his battery; and for this purpose, at the commencement of the march, sends a trustworthy mounted orderly to him for orders. If the battery takes up a position and opens fire, the Commander of the 2nd echelon advances it to 900 yards from the battery, if practicable, and halts it on the side of a road. The points to be attended to in selecting this position are, that it can be easily found by those in charge of the wagons, that it is under cover as far as possible, and that it allows of easy movement to the front and rear.

As soon as the 2nd echelon is drawn up, its Commander informs the Commander of the 1st echelon of its position. If the battery advances, the 2nd echelon follows; local conditions, and the opportunity of cover, determining whether the latter can decrease its distance from the first echelon; the Commander of which must similarly endeavour to keep himself acquainted with the movements of the 2nd echelon.

Conduct of the Second Echelons of Batteries forming a Division.

The Officer in command of these echelons, from his position in rear of the columns on the march, maintains his communication with the Officer commanding the Division, or, at all events, informs himself as to the movements of the batteries. For this purpose he sends a mounted orderly to the Commanding Officer for orders. On marches, when there is no fighting, this orderly brings directions as to the can-¹

tonments, bivouacs, &c., of the different batteries, so as to save the 2nd echelons unnecessary marches and to enable them to rejoin their batteries as soon as possible.

If the batteries come into action, the Officer commanding the 2nd echelons endeavours to advance to 900 yards from them, which frequently demands great energy and foresight. He then halts his wagons at the side of the road, and informs the Divisional Commander as well as the different batteries of his position. That Officer decides whether, under the circumstances, any one of the echelons should follow its battery. When detachments from various batteries are united in this manner, the Officer is responsible for maintaining the strictest discipline. The conditions which decide the choice of position and the distance from the 1st echelons apply equally in this case as in that of single batteries.

Supply from the Second Echelon.

The 2nd echelon has to make good the losses of the battery and of its 1st echelon, and this must be performed with utmost promptitude, regardless of the consideration whether the parts of the 2nd echelon retain their power of movement; the guns are, under all circumstances, to be first considered. If the 2nd echelons of a division are united, the supply is to be made by requisition of each battery from its own 2nd echelon. When this is exhausted, the Divisional Commander will decide whether and from which 2nd echelon a further supply is to be obtained.

Supply of the Second Echelon of Batteries from the First Echelon of the Ammunition Columns.

The positions of the latter are communicated as early as possible to every battery; if a battery has been accidentally forgotten, its Commander must enquire where the columns are. The leader of the 2nd echelon makes himself acquainted with the road to them, and sends a mounted man to find the columns. Orderlies may be employed with advantage for this purpose if available. Empty wagons from the 1st echelon remain during the fighting with the 2nd echelon, and others complete themselves from the columns as soon as circumstances permit.

Conduct of the Echelons after the Battle.

After an engagement, or completing a march, the 2nd echelon rejoins its battery with all despatch, and makes itself as serviceable as possible. Empty wagons are sent without delay to the nearest columns, and after completing their supplies, return to their batteries. The unserviceable material, if transportable and of any value, is taken to the nearest columns, to be exchanged or repaired.

General Directions for the Receipt of Ammunition.

In completing empty battery-wagons from the columns the recipient signs a receipt, a supply of which should be provided with every

wagon of a battery or column; the duplicate is kept by the battery as a delivery voucher. Ammunition issued from the columns is to be examined by the recipient with the greatest care, especially with respect to fuzes.

Junction of other Troops with the Echelons.

This, as in the case of S. A. ammunition wagons joining battery echelons, is contrary to orders, as the duty of supplying ammunition to the batteries would be more or less interfered with; and the attention entailed by the presence of other troops would be prejudicial to mobility. But the wagons of a Cavalry Division may always be attached to the Horse Artillery batteries of the Division by order of the officer commanding the Division.

NOTES ON THE PRESENT ORGANIZATION AND ADMINISTRATION OF THE FRENCH NAVY.

By Captain J. L. NEEDHAM, Royal Marine Artillery.

I. ADMINISTRATION.

Chief and head of the administration of the French Navy stands the Minister of Marine, assisted in the performance of the duties of his office by—

(A.) Directors of Departments; each one having under his orders a certain number of employés, and having authority to sign, in the name of the Minister, all documents and despatches which do not involve any political, administrative, or financial decision.

(B.) A Central Control; giving advice with regard to any propositions submitted by any of the Directors of Departments to the Minister, which if approved would entail expenditure or establish a precedent.

(C.) Councils, Committees, and Commissions; which aid the Minister by deliberating upon, discussing, and investigating matters connected with the several branches of the Naval and Colonial Service.

(A.) Directors of Departments.

By the law of the 23rd of October, 1873, five Departments (*Directions*) were constituted for the conduct of all business connected with the central administration of the French Navy and Colonies. Of these five Departments, the first is charged with all matters concerning the *personnel* of the Fleet; the second with everything regarding the

NOTE.—The information contained in these notes is derived mainly from a series of articles on the subject recently published by the Accountant-General of the French Navy, from the *Bulletin de la Marine*, and from the Naval Estimates for the present year, 1877.

matériel; the third with the administrative services; the fourth with the colonial services; and the fifth with everything relating to the accountant business of the Navy (*comptabilité générale*).

At the head of each Department stands the Director. Next below him, but ranking with him, comes the *Chef de Cabinet*, then in succession the Sub-Director, the *Chef de Bureau*, the *Chef Adjoint*, the Sub-Chief, the Chief Clerk, and, finally, Clerks, these latter being divided into four classes. The Director of each Department is nominated by the Chief of the State, on the proposition of the Minister of Marine. Vacancies occurring in the other ranks are filled up by promotions from the grade below; but two years' service in each rank is a necessary qualification for advancement to the one next above.

(B.) *Central Control.*

The especial duty of the Central Control is to keep the Minister of Marine at all times fully informed of everything that goes on within the limits of his administration. It has to maintain a constant surveillance over all that takes place both at home and abroad; to report, or, it may be, check, if it can do so without interfering with the action of responsible officials, any irregularities it may observe. Its work is, therefore, essentially one of inspection, and for the fulfilment of this task six General Inspections (*Inspection Générale*) and two special services, which partake of the nature of an inspection, are comprised within it. The six General Inspections are distinguished as the Inspection General of Naval and Colonial Artillery; the Inspection General of Maritime Engineering (*Génie Maritime*); the Inspection General of Maritime Works; the Inspection General of Marine Infantry; the Inspection General of the Medical Services; and the Inspection General of Chaplains. The two special services are the Inspections of Fuel and the Inspection of Work entrusted to private firms. These Inspections General play so important a part in the administration of the French Navy that it will be well to consider somewhat in detail their respective functions and attributes.

1. The Inspection General of Naval and Colonial Artillery, as at present constituted, was re-established and reorganized by a decree, dated the 23rd of October, 1871. It consists of a General of Division of Marine Artillery, who is entitled Permanent Inspector-General, and of a Brigadier General of the same arm, under the name of *Adjoint à l'Inspection Générale*. Besides the special and unexpected inspections which are made from time to time, in compliance with instructions received from the Minister, by the Permanent Inspector-General and his Adjoint, this latter also proceeds at stated periods on periodical tours of inspection both in France and in the Colonies; while the Inspector-General himself, when not employed on the special missions spoken of, occupies himself in studying and preparing, as a part of his duty as a member *ex officio* of the "Council of Works," the functions of which will be explained later on, projects, plans, and instructions relating to the provision, maintenance, and improvement of the artillery *matériel*, both in France and in the Colonies, and also in arranging for the execution of the approved designs.

2. The Inspection General of Maritime Engineering continues to perform the duties allotted to it by the decree of the 11th of April, 1854, the 11th article of which contains the following regulations. "The Inspector-General of Maritime Engineering will reside in Paris, " and will be assisted by a Director of Naval Constructions. The Inspector-General will make, at the instance of the Minister, tours of "inspection to the various ports, to assure himself that all work on "hand is being properly executed. He will advise as to the destination of officers of all ranks of the Maritime Engineers. He will lay "before the Minister the measures necessary for ensuring uniformity "in the execution of all works of similar nature in the several arsenals, "for introducing into the government factories the knowledge and "practice of new inventions in mechanical art, for obtaining economy "in expenditure, and for perfecting naval architecture. He will also "bring to the notice of the Minister any deviations he may observe, "or of which he may become cognizant, from the authorised instructions and regulations relating to the construction and armament of "the ships of the State or the conduct of works."

3. The Inspection General of Maritime Works consists of an Inspector-General of Bridges and Roads (*ponts et chaussées*), attached for this duty to the Minister of Marine, and of a Chief Engineer of the same corps. This Inspection was established on its present footing by the decree of the 13th of October, 1831, and is charged with the surveillance of all hydraulic and civil works executed by order of the Minister.

4. The Inspection General of Marine Infantry is composed of a General of Division of Marine Infantry and two Generals of Brigade. Revised instructions for the guidance of this Inspection were issued in a Ministerial decree, dated the 9th of July, 1874. In these regulations it is distinctly laid down that neither the Inspector-General nor his assistants exercise any direct command over the *personnel* of their arm. When not engaged on tours of inspection, however, the Inspector-General is authorised to correspond through the Maritime Prefect, or through the Governor, with the Commanding Officers of the Corps both in France and in the Colonies, in order that he may keep himself fully conversant with the details of the service; but it is expressly stated that such correspondence shall be carried on for the sole purpose of acquiring information, and that, under no circumstances whatsoever, shall any communication from the Inspector-General contain any orders or directions to the officers commanding at the several stations. On the other hand, the Inspector-General may take the initiative at head-quarters in laying before the Minister any proposition relating to his branch of the service. He will also be consulted by the Directors of Departments on all questions regarding the organization, administration, pay, clothing, equipment, armament, &c., of the Marine Infantry; and at the beginning of every year, after having deliberated with his assistants and received the reports of the other Inspectors-General in the Colonies, he will draw up and present to the Minister a report on the general situation of his arm of the service.

5. The Inspection General of the Medical Services was organized

on its present footing by a decree of the 14th of July, 1865. The Inspector-General resides in Paris, and corresponds, under restrictions similar to those imposed upon the Inspector-General of the Marine Infantry, with the principal Medical Officers at the several ports. He is consulted as to the employment of all the officers of his branch of the service; he proceeds from time to time, by order of the Minister, on visits of inspection to the various arsenals and naval establishments; he proposes to the Minister any ameliorations which it may seem expedient to effect; and at the end of every year he presents a detailed report of the general situation of the Medical Department.

6. The Chaplain-in-Chief of the Fleet proceeds on tours of inspection whenever the Minister deems it advisable that such visits should be made. He lays before this latter the names of candidates for chaplaincies in the Navy, and issues their instructions to them when they embark or proceed on foreign service. He is assisted in the discharge of his duties by a Superior Chaplain (*aumônier supérieur*), who lives in Paris, and receives his instructions from the Chaplain-in-Chief.

The Inspection of Fuel, consisting of two captains of frigate residing in Paris, and having under their orders a number of master mechanics (*maîtres mécaniciens*) of the Navy, who are stationed at the several mines, superintends the execution of all contracts for fuel entered into with mining companies; and the Inspection of Work executed by private firms, with which were amalgamated, by a decision of the 2nd of February, 1874, the Forest and Receipt Services (*Service Forestier* and *Service des Recettes*), supervises, by means of subordinate officials detached to the private dockyards and manufactories where Government work is being executed, the progress of everything entrusted to private firms.

(C.) *Councils, Committees, and Commissions.*

It has been already stated that the Minister of Marine is assisted in the performance of his duties by certain councils, committees, and commissions, which deliberate upon, discuss, and investigate matters connected with the several branches of the naval and colonial service. Some of these bodies have a permanent, others a semi-permanent constitution. Among the former are included the Admiralty Council (*Council d'Amirauté*), the Council of Works, the Superior Council of Health, the Legal Council (*Comité consultatif du contentieux*), the Prize Council, the Clothing and Equipment Commission, the Commission of Submarine Defences, the Central Commission for the examination of the works of Officers, the Library Commission, and the Contract Commission. The semi-permanent bodies include the Lighthouse Commission, the Public Works Commission, and the Coast Defence Commission.

The appellation of most of these commissions sufficiently indicates the nature of the duties which they have to perform; but a short additional explanation of the peculiar functions of some of the more important of them will not be without interest.

1. The Admiralty Council was organized on its present footing by a decree of the 23rd of October, 1871. The work it performs is two-

fold. On the one hand it advises on all measures relating to the general administration of the Navy and Colonies. On the other hand, in its character of an impartial judge of the services and merits of every officer, it prepares each year the lists by which promotion in the several branches of the service is governed. The Minister of Marine himself is President of the Council, which consists, besides, of eight titular members, who alone have the power to vote, namely, five "general officers" of the Navy (*i.e.*, Vice or Rear-Admirals), one General of Marine Artillery, one Inspector-General of Maritime Engineers, and one Commissary General of the Navy, and of two assistant members (*membres adjoints*), usually Captains of the Navy, who attend all the sittings of the Council, but who have no vote excepting when they replace an absent titular member, and finally of a secretary, who is also, as a rule, a Captain. All the members are appointed for three years, but may be re-elected. The assistant members must, however, serve for two years either on board ship or in a naval port, before they are eligible for re-appointment. Finally, it may be remarked that the decree of 1871 referred to above, distinctly lays down, that the Minister alone is responsible for the measures he adopts or recommends, and is never in any way bound to follow the advice or accept the opinion of the Admiralty Council.

2. The Council of Works consists of two Vice-Admirals, the senior one of whom is president, a General of Division of Marine Artillery, a General of Artillery, a Rear-Admiral, an Inspector-General of Maritime Engineering, an Inspector-General of Roads and Bridges, a Director of Naval Constructions, two Captains of the Navy, two Colonels of Marine Artillery, two Engineers of the first class, one Engineer-in-Chief of Roads and Bridges, and a Sub-Engineer of Naval Constructions as secretary, but this last-named Officer can neither vote nor take part in the deliberations of the Council. A general officer of the army is also added temporarily to the Council whenever it has to decide upon questions relating to the manufacture of ordnance or connected with artillery experiments. The appointments to this Council are for a period of three years in the case of general officers, and of two for "superior officers;" but all members are eligible for re-election. The Council of Works deliberates and gives advice upon the following subjects. All projects, plans, and reports relative to the construction, fitting, and armament of men-of-war, or to buildings which it is proposed to erect at any of the naval ports, either in France or in the Colonies; and it also examines and reports upon all new inventions which may be submitted to it. To facilitate the study and discussions of such varied subjects the Council is subdivided into four sections. One of these devotes its attention to nautical questions; the second to matters relating to machinery; the third to artillery, and the fourth to hydraulic works and buildings on shore. Finally, when the Council of Works has examined into any matter laid before it, the result of its deliberations is submitted to the Admiralty Council by a member of the former body, who is charged with the explanation of the considerations which have governed the vote of the majority of the members of the Council of Works.

3. The Superior Council of Health, which consists of three of the principal Medical Officers of the Navy, with a surgeon of the first or second class as secretary, advises on all questions submitted to it by the Minister relative to the medical department of the Navy and Colonies, the health of the men, the construction of hospitals, the sanitary arrangements of prisons and barracks, the organization of naval and colonial hospitals, &c. It is also charged with the revision of the medical instructions, and especially of those issued to scientific expeditions; it prepares each year the programme of the studies to be pursued in the naval medical schools, and determines the character of the questions to be set at the examinations for the various ranks in the naval medical department.

II. ORGANIZATION.

The whole territory of France is divided, by a decree of the 14th of June, 1844, into five naval arrondissements (*arrondissements maritimes*).

The first arrondissement comprises the ports and coasts of the Channel from the Belgian frontier to Cherbourg; this latter place being the chief port (*chef-lieu*) of the arrondissement. The whole arrondissement is divided into three sub-arrondissements; the chief ports of which are Dunkerque, Havre, and Cherbourg respectively.

The second arrondissement comprises the ports and coasts of the ocean from Cherbourg to the right bank of the river Belon, and also the adjacent islands. Its chief port is Brest, and it is divided into two sub-arrondissements, having their chief ports at Saint-Servan and Brest.

The third arrondissement comprises the ports and coasts from the right bank of the river Belon to the port of Roche, in the Bay of Bourgneuf, and the adjacent islands. Lorient is its chief port, and it is divided into two sub-arrondissements, of which Lorient and Nantes are the chief ports.

The fourth arrondissement comprises the ports and coasts from the port of Roche, in the Bay of Bourgneuf, to the frontier of Spain, and the adjacent islands. The chief port is Rochefort, and it is divided into two sub-arrondissements, having their chief ports at Rochefort and Bordeaux.

Finally, the fifth arrondissement comprises the French ports and coasts of the Mediterranean, the adjacent islands, and the island of Corsica. The chief port is Toulon, and it is divided into three sub-arrondissements, with chief ports at Toulon, Marseilles, and Bastia respectively.

In Algeria the naval service is constituted in a peculiar manner, which will be described hereafter.

Administration of Arrondissements.

In the administrative organization of these naval arrondissements the same principles will be found put into practice which govern the organization of the central administration in Paris. Everything is ordered with a view to obtaining unity of command, and separation of the

administrative from the executive service and from the control; special councils to assist by their advice, and heads of departments or chiefs of the several services, independent one of the other but each having his duties clearly and strictly defined, being placed by the side of the higher authority, which decides and directs; and which is alone responsible for the proper working of the whole system under its direction.

In each of the five naval arrondissements there are, beginning at the highest rank, the following officials:—A Maritime Prefect (*Prefet Maritime*); a Major-General; a Major of the Fleet; a Naval Commissary General; a Director of Naval Constructions; a Director of Movements in the Port; a Director of Artillery; a Medical Director; a Director of Hydraulic Works and of Buildings, and an Inspector-in-Chief of the Administrative Services of the Ports. These several officials have each their strictly defined duties, which they perform independently; and they also compose, when assembled together, a council of administration.

1. The Maritime Prefect of an arrondissement must, according to the provisions of a decree issued in 1863, be chosen from among the Vice-Admirals of the Navy, and while in office he enjoys the honours and dignity of a Vice-Admiral commanding a fleet. In the matter of precedence he takes rank, in the chief port of his arrondissement, before the General of Division commanding the army corps stationed in his district; but, elsewhere in the command of the General, he ranks after this latter. The functions of the Prefect may be summarised in the words of the decree of 1844, which lays down that "he shall have the supreme direction of all the naval services and establishments in his arrondissement." He receives his orders directly from the Minister, and he alone can correspond with this latter concerning the direction of the several services in his arrondissement. Excepting where a special decree provides otherwise, all the armed vessels in his arrondissement are under his direction; save those placed under the orders of the military authorities, or of an officer commanding a squadron or division. The security of the ports and arsenals, the police of the harbours, the service in the forts and batteries which protect them, the protection of the coast, of the coasting trade, and the police of the maritime fisheries are all confided to him, and, with the assistance of the council of administration, he regulates the expenditure in his arrondissement within the limits laid down by the Minister.

2. The Major-General of a naval arrondissement performs duties in many respects similar to those of a General of Brigade, or the commandant of a fortress. In regard to precedence he ranks with Brigadier-Generals according to the date of commission. In the absence of the Prefect he takes the place of this latter. Naval officers of all ranks, cadets, volunteers, and the divisions of sailors are all under his orders. The security of the chief port of the arrondissement, the forts, batteries, and posts which are garrisoned by the Navy, the naval prisons, the signalling stations, &c., are all entrusted to his care and supervision. Ships fitting out and paying off are also under his

authority, and he is informed each day of the progress of the work on board of them. He presides at the Commission which inspects them when they depart and when they return; and, finally, he keeps the sea and land service rosters of the officers belonging to his arrondissement.

3. The Major of the Fleet is a "superior" or sometimes a "general Officer" of the Navy, and is nominated by the Chief of the State. His principal duty consists in centralising the service of the reserve vessels, and in watching the execution of all work on board either steam or sailing ships. He is kept informed of all orders which are given to the heads of departments relative to these vessels, satisfies himself that they are being properly carried out, and gives account of their execution to the Prefect. He also acts as an intermediary between this latter and the Captains, receives the reports of these last-named Officers, examines them, makes his remarks upon them, and transmits them to the Prefect. He visits vessels returning into port, satisfies himself that all regulations have been properly carried out, and examines the condition of the hull and machinery. He forms part of the Commission charged with the trial, reception, and condemnation of machinery; and, finally, he superintends the storage of coal in the port, and its issue to ships.

4. The Director of Movements in the Port is a Captain of the Navy. He is charged with the custody of all vessels not in commission lying in his port; with the placing and displacing of their masts and spars, of their ballast, and in general with all their movements in the port; he is also in charge of all workshops, where work connected with his service is being performed; he has the care of all pumps, engines, and fire escape gear; of all moorings laid down in the harbour; of all lighthouses and signals maintained by the Navy, and finally he superintends the pilot service of his port.

5. In every naval port the Director of Artillery is usually a Colonel. He is entrusted with all the works connected with his arm of the service; he has charge of the workshops and laboratories, of the experiments made with ordnance, &c.

6. The Inspector-in-Chief of the Naval Administrative Services in a Port is charged, in the name of the Minister, with the supervision of all parts of the Administrative Services. He belongs to the first or second class of this rank, and is subordinate to the Maritime Prefect; but only in respect of rank. He receives orders from the Minister only, and corresponds directly with him. He sees that the chiefs of the services, including if necessary, the Prefect himself, punctually comply with all laws, regulations, and ministerial orders, and he informs the Minister, after having given notice of his intention to the Prefect, of any representations which he may have made and which have not been attended to. He supervises the receipt, storing, and employment of all material and supplies belonging to the State. Consequently, all the stores, workshops, offices, and other establishments are open to him and to his inspecting officers. He belongs to a special corps, ranks with a Commissary General according to date of commission, and is nominated by the Chief of the State.

Councils of Administration.

In the chief port of every arrondissement a "Council of Administration" is formed, presided over by the Maritime Prefect, and consisting of the Major-General, the Commissary General, the Director of Naval Constructions, the Director of Movements in the Port, the Director of Artillery, and the Director of Hydraulic Works; a Sub-Commissary nominated by the Maritime Prefect, discharging the duties of secretary. The Council holds its meetings at the residence of the Prefect, as often as this latter may choose to convene it; but it must be assembled at least twice a month. It is informed by the Prefect of all questions and matters which may arise from time to time relating to the naval service, and advises upon them; but in certain cases it may give summary decisions, subject to the approbation of the Minister. Its decision or opinion on any matter is determined by the vote of the majority, the President having a casting vote where the votes are otherwise equally divided. Any member, however, has a right to have his opinion entered in the record of the proceedings, when it is at variance with the decision of the majority.

Thus, as at the Ministry, so in each arrondissement, the Maritime Prefect Commanding-in-Chief exercises full authority throughout his arrondissement, aided by the advice given him by the council of administration and assisted by the various heads of departments and chiefs of service residing at the chief port.

Sub-Arrondissements.

The chief ports of the sub-arrondissements, which are distinguished as secondary ports (*ports secondaires*), are Dunkerque and Havre in the first arrondissement; Saint-Servan in the second; Nantes in the third; Bordeaux in the fourth; Marseilles and Bastia in the fifth. The chief of the naval service in each of these sub-arrondissements is a Superior Officer of the Naval Commissariat. When, however, extraordinary works, either of construction or armament, are taking place, the exercise of the principal authority may be assigned to a naval officer or an officer of the Maritime Engineers. When this latter contingency occurs, the Commissariat Officer exercises the functions of a Commissary General in a naval port. Although placed under the orders of the Maritime Prefect, the chief of the naval service in a secondary port may, when the exigencies of the service require it, correspond directly with the Minister; but, should he do so, he must inform the Prefect of the nature of his communications.

The sub-arrondissements again are sub-divided into quarters, sub-quarters, and syndicates (*quartiers, sous-quartiers, et syndicats*). The functionaries and agents who look after the interests of the naval service in these various sub-divisions bear the titles of commissary of maritime inscription in the quarters; administrators in the sub-quarters, and *syndics des gens de mer* in the syndicates. Naval gendarmes, maritime guards, and inspectors of fisheries are also attached to the naval service in the quarters.

The Naval Service in Algeria.

The naval service in the French possessions on the north of Africa is directed, under the authority of the Governor-General, by a Rear-Admiral, who bears the title of Commandant of the Navy, and who resides in Algiers. Under his orders the administrative service is entrusted to a naval commissary. A council of administration, similar to those which exist in the naval ports of France, was also instituted in Algeria by an Imperial decree dated the 26th of June, 1869, composed of the Rear-Admiral commanding, the Commissary at the head of the naval service, and the Captain acting as Captain of the Port at Algiers. The whole sea coast is divided into twelve sections, at the head of which is placed a naval Officer; but the maritime inscription has not yet been organized in Algeria. The local Fleet consists at the present time of a corvette, a transport, and a brig stationed at Algiers, and serving as a school ship for native boys.

III. OFFICERS OF THE NAVY.

The commissioned ranks of the French Navy are recruited from four sources. In the first place by Cadets from the Naval School; secondly, by Cadets from the Polytechnic School; thirdly, by giving the commission of *enseigne de vaisseau* to first masters (*premiers-maîtres*) who have passed a certain prescribed examination, and fourthly, by admitting to the same rank auxiliary *enseignes de vaisseau* who are provided with the certificate of *capitaine au long cours*. Commissions, however, are only given to this latter class of officers in time of war, and when it is impossible to obtain otherwise the necessary supply of officers.

The several grades in the commissioned ranks, beginning from the lowest step, are as follows:—

Cadet of the 2nd Class having no relative Army rank.

Cadet of the 1st Class ranking with a 2nd Lieutenant of Artillery.

Ensign (*enseigne de vaisseau*), ranking with a 1st Lieutenant of Artillery.

Lieutenant, ranking with a Captain in the Army.

Captain of frigate, ranking with a Lieutenant-Colonel.

Captain (*capitaine de vaisseau*), ranking with a Colonel.

Rear-Admiral, ranking with a Brigadier-General.

Vice-Admiral, ranking with a General of Division.

Admiral, ranking with a Field-Marshal.

Of the above, Admirals, Vice-Admirals, and Rear-Admirals are designated "General Officers;" both classes of Captains "Superior Officers," while Lieutenants, Ensigns, and Cadets of the 1st Class are included under the simple term of "Officers."

The Vice- and Rear-Admirals, again, form the cadre of the general staff (*l'état-major général*) of the Navy. This cadre is divided into two sections; the first comprising active and disposable officers, the second reserve officers. In time of peace it is prescribed that the first

section shall not include more than fifteen Vice- and thirty Rear-Admirals. It is further laid down that Vice-Admirals on completing their sixty-fifth year, and Rear-Admirals on attaining their sixty-third birthday, shall cease to belong to the first, passing into the second or reserve class. In time of peace, only Admirals in the first or active section are eligible for employment; but in time of war "general officers" of the second section also may be appointed to commands, both at sea and on shore. Similarly, officers nominated to a seat in the Admiralty Council must be chosen from among those in the first section. This compulsory age retirement of the general officers of the Navy is however modified by a provision contained in the law of the 1st of June, 1841, to the effect that Vice-Admirals, who have held the command-in-chief of a naval force in time of war, and who have especially distinguished themselves by eminent services, shall be retained in the first section irrespective of age.

The promotion of Officers in the French Navy takes place in the lower grades, up to and including the rank of Captain of frigate, partly by selection, but mainly, and in time of peace practically, almost without exception, by seniority; but in the higher ranks, from Captain of frigate upwards, promotion is given altogether by selection. An officer must, however, in every case serve a certain time in each rank before he can be advanced to the next higher, as will be seen by the following summary of the regulations for promotion.

The highest dignity in the French Navy, that of Admiral, can only be conferred upon a Vice-Admiral who has held the command-in-chief of a naval force during time of war, and who in that position has rendered distinguished service.

No one can be promoted to the rank of Vice-Admiral unless he has served two years at sea as a Rear-Admiral in a squadron or naval division. Similarly, no one can be promoted to the rank of Rear-Admiral who has not served three years in command at sea as *capitaine de vaisseau*; or unless he has held that rank for at least four years, during two of which he must have served at sea as the commissioned Commander of a division of three men-of-war. Again, before an officer can be promoted to the rank of *capitaine de vaisseau*, he must have served on board ship for three years as Captain of frigate, during one year at least of which he must have been in command of a vessel; or he must have held the rank of Captain of frigate for four years, during two of which he must have been in command of his ship. To be promoted to Captain of frigate an officer must have served for four years as Lieutenant, two of them on board ship. To be promoted to Lieutenant he must have served on board ship at least two years as *enseigne de vaisseau*, and, finally, before he can be promoted to this last-named rank, he must have served again at least two years on board ship as a Cadet of the first class. First-masters may be promoted to ensigns when they have served for two years in the former capacity on board ship, provided that they can pass a satisfactory examination in the theory of navigation as well as in the practical work of their profession.

The number of officers of each rank in the French Navy and the

pay to be received by them, is laid down in the estimates for the present year (1877) as follows.—

	Pay on shore.	Pay at sea.	Reserve pay.
2 Admirals.....	30,000 frs.	30,000 frs.	9,000 frs.
15 Vice-Admirals	18,000 „	21,000 „	6,000 „
30 Rear-Admirals	12,000 „	14,000 „	—
100 Captains.....	6,500 „	7,600 „	—
200 Captains of frigate	5,000 „	6,000 „	—
350 Lieutenants, 1st Class ..	3,000 „	3,600 „	—
350 Lieutenants, 2nd Class ..	2,500 „	3,000 „	—
420 Ensigns	2,000 „	2,400 „	—
140 Cadets, 1st Class	1,600 „	1,600 „	—

The embarkation of officers is governed by a roster (*liste d'embarquement*) for each rank, kept at the head-quarters of each arrondissement by the Maritime Prefect, each port supplying officers in turn and in proportion to the number attached to it. Every officer, up to the rank of Rear-Admiral exclusive, is attached for this purpose to one or other of the naval ports, which becomes his *port d'attache*. When not actively employed, the junior officers, Ensigns, and Lieutenants, must reside at such port, but Captains of both classes may live elsewhere; and when the number of officers at any particular ports falls below the number necessary to carry on the service there, the Minister of Marine supplements the deficiency by attaching to it officers from other ports where there is an excess in numbers. The officers required for service at sea are taken from the top of the rosters of their respective ranks, those required to fill appointments on shore from the bottom. Lieutenants who are nominated to permanent appointments on shore, relinquish by their acceptance of such post, their right to promotion with other Lieutenants who remain in the general service; but they are permitted to retain their appointments until they attain the age of fifty-five.

Finally, officers who pass through and obtain certificates from the gunnery, torpedo, musketry or gymnastic schools, are placed upon special lists and enjoy certain advantages.

IV. CREW OF THE NAVY.

The whole *personnel* of the French Navy on shore is distributed into five "Divisions." Of these there are two of the first class, stationed, the one at Brest, the other at Toulon, and three of the second class, quartered at Cherbourg, Lorient, and Rochefort. Each division, whether of the first or second class, is commanded by a captain *de vaisseau*, and in each there is formed a council of administration, which looks after the clothing, the pay, and the general administrative work of the division.

Each division of the first class consists of a staff and of the following dépôt companies:

- 1 company of seamen gunners (*matelots canonniers*);
- 1 company of small arm men (*matelots fusiliers*);

- 1 company of artificers and stokers;
- 3 companies of sailors of the maritime inscription;
- 1 company of sailors *du recrutement*.

Each division of the second class comprises a staff and the following dépôt companies :

- 1 company of the special branches;
- 2 companies of sailors of the maritime inscription, and *du recrutement*.

The Lorient Division includes, in addition to the above, a battalion for the instruction of small arm men; while in each Division there are certain schools of instruction, as for instance a school of fencing, a swimming school, an elementary school, in which certain subjects laid down in the regulations are taught, and a gymnasium. In each of the first two Divisions there is also a school of music; and at Rochefort there is a normal school for training the schoolmasters of the fleet.

The first-masters, masters, and second-masters of the various special branches of the service, form the cadre of the warrant officers of the fleet. With equal rank they are classed as follows:—Manœuvre, gunnery, musketry, steering, artificers, carpenters, sailmakers, and caulkers. When not employed on board ship or with a Division, these masters remain at home *en disponibilité*, receiving a reduced rate of pay, and being recalled to active service in rotation.

Topmen (Gabiers brevetés).

The rating of topmen (*gabiers brevetés*) was instituted in 1866 with a view of retaining in the service a class of men, the number of whom was found to be rapidly decreasing as the number of steam vessels increased. Sailors who can pass a prescribed examination receive, according to their drill and efficiency, the rating of topmen of the first or second class, which gives them an increase of 25 or 20 centimes to their daily pay. Two sailing vessels, which are employed as training ships, receive every year a certain number of candidates for the rating, and these, after a voyage of five months, may present themselves for examination.

Seamen Gunners (Matelots Canoniers).

The candidates for this rating receive their preparatory instruction either on board the men-of-war in which they are serving as sailors, or in one of the dépôt companies of seamen-gunners at Brest and Toulon; their education being completed on board an armed vessel, which serves as a gunnery training ship. The course of instruction in this latter vessel lasts for eight months, after which men qualifying are examined, and receive, according to the aptitude they display, a certificate of the first, second, or third class. They then return to their respective divisions, and await their turn for embarkation, receiving extra pay according to the class of certificate they have obtained. After holding the rating for at least two years, they return again for four months to the training ship, after which, if they can pass another and higher examination, they become "veteran gunners of the fleet"

(*canonniers-vétérans de la flotte*), and receive a higher rate of extra pay.

Small-arm Men (Marins Fusiliers).

Officers of the Navy, Lieutenants, and Ensigns, receive theoretical and practical instruction in musketry at the school at the Camp of Chalons, and in the instructional battalion at Lorient. Sailors are instructed only in the battalion. This battalion is under the direction of a field officer of Marine Infantry, and under the orders of the Commandant of the Lorient Division. All men attached to it are divided into companies, the cadres of which, officers included, are supplied likewise by the Marine Infantry. At the termination of their period of instruction the men undergo both a theoretical and practical examination, and receive a first, second, or third class certificate according to the aptitude they display. They are then distributed, as the necessities of the service may require, among the Divisions of the five maritime arrondissements, where they await their turn of embarkation, receiving like the seamen gunners, extra pay according to the class of certificate they have obtained. The musketry instruction on board ship and the field exercises of the crew are carried on by officers who have been through the school of musketry at the Camp of Chalons, whither a certain number of *capitaines d'armes*, and *sergents d'armes* are also sent from time to time to obtain the Army musketry certificate.

Helmsmen (Matelots-timoniens).

Sailors wishing to qualify for this rating receive, as *apprentis-timoniens*, the necessary preliminary instruction either in the companies of topmen established in the Divisions of Brest and Toulon, or on board training ships. They are then embarked on board two men-of-war, which are specially employed as schools of seamanship, and at the end of their course of instruction receive, according to the amount of knowledge they have acquired and the aptitude they display, a first or second class certificate, which entitles them to occupy, to the exclusion of all others, when embarked on board any man-of-war, all ratings in the quartermaster's department for which extra pay is given.

Mechanicians and Stokers of the Fleet (Mécaniciens et Chauffeurs de la Flotte).

The ratings among the artificers and stokers of the French Navy are first-masters, second-masters, quartermasters, and mechanician pupils (ranks corresponding with those of like designation existing in other branches of the service), and stokers of the first, second, and third class, corresponding to sailors of the same denominations. On shore the mechanicians and stokers are employed in working and keeping in order the steam machinery, both in the dockyards, workshops, and on board vessels not in commission. On board ship they are charged with the working, maintenance, and repair of the engines.

Chief Mechanicians and Principal Mechanicians (Mécaniciens en Chef et Mécaniciens Principaux).

To place the mechanicians of the French Navy (a class corresponding to the Engineers in the English service) on a footing corresponding to the importance and responsibility of the duties devolving upon them through the development of steam navigation, a decree of the 25th of September, 1860, created the rank of Chief Mechanician, ranking with the old Captain of Corvette; Principal Mechanician of the First Class, ranking with a Lieutenant of the First Class, and Principal Mechanician of the Second Class, ranking with an *enseigne de vaisseau*.

The chief and principal mechanicians are nominated by decree from among the master mechanicians of the fleet. On shore they are under the direction of the Major of the Fleet; but for disciplinary purposes they are under the orders of the Major-General. They are especially charged with the instruction of men belonging to the companies of artificers and stokers. At sea they are entrusted with the supervision of the machinery of all the ships of the division to which they are attached.

The Naval Estimates for the present year, 1877, provide for the following establishment of chief and principal mechanicians:—

	Pay at sea.	Pay on shore.
2 Chief Mechanicians	5,400 francs	4,500 francs.
8 Principal Mechanicians, 1st Class. .	3,400 "	3,000 "
40 Principal Mechanicians, 2nd Class "	2,400 "	2,000 "

V. MARINE AND COLONIAL TROOPS.

Among the above are included the following corps:—

1. Maritime Gendarmerie.
2. Colonial Gendarmerie.
3. Marine and Colonial Artillery.
4. Marine Infantry.
5. Naval Armourers.
6. Sénégal Tirailleurs.
7. Sénégal Spahis.
8. Corps of Cipahis.
9. Disciplinary Companies.
10. Colonial Disciplinary Corps.
11. Warders of Penal Establishments in the Colonies.
12. Colonial Militia.

1. *The Maritime Gendarmerie.*

The Maritime Gendarmerie is a small corps of 621 men, divided into 5 companies, one of which performs the police duties in each of the five maritime arrondissements.

2. *Colonial Gendarmerie.*

This corps, like all other colonial troops, is included in the department of the Minister of Marine, and consists of one company of

gendarmeries in each of the colonies of Martinique, Guadeloupe, Réunion, and New Caledonia, and of detachments in Guyane, Senegal, St. Pierre de Miquelon, Taiti, and Cochin China. The force is recruited from among the departmental gendarmerie of France, and is divided into horse and foot brigades.

3. *Marine and Colonial Artillery.*

The corps of Marine Artillery is entrusted with the following duties: the manufacture and construction of ordnance, projectiles, and artillery matériel generally for the fleet; the arming of forts and batteries designed for the protection of ports and harbours; the direction of all artillery work in the naval arsenals; the artillery service in the Colonies, and, in default of other troops it may be called upon to guard the several establishments in the naval ports.

The general staff of the corps consists of a General of Division, who is Inspector-in-Chief of the service, and two Generals of Brigade. The ordinary staff comprises 9 Colonels, 8 Lieutenant-Colonels, 7 Squadron Chiefs (*Chefs d'Escadron*), and 40 First Captains. The troops of the Marine Artillery consist of 1 regiment, 6 companies of workmen, 1 company of artificers, and a corps of armourers. The regiment consists, besides the staff, of 28 batteries, and a company of *Conducteurs*.

In the staff of the Marine Artillery are also included, under the name of military *employés*, a body of men entitled guardians (*gardes*), organized by a decree of the 5th of July, 1875, and also a body known as battery guardians (*gardiens de batterie*). This latter body is entirely recruited from among non-commissioned officers of Artillery, and petty officers of the Navy.

4. *Marine Infantry.*

The Corps of Marine Infantry is composed of four regiments, which perform garrison duty in the five naval ports of France, and in the establishments abroad, and which may be embarked as an expeditionary force in the case of a naval war. Should it be necessary they may also be required to furnish detachments for service on board men-of-war.

The general staff of the corps consists of a General of Division, charged with the duties of Inspector-General, and of two Brigadier Generals, who assist the first-named Officer. Besides the regimental cadres, the corps also includes a number of officers, non-commissioned officers, buglers, &c., to form the cadre of (1) the musketry instructional battalion, which has been spoken of above as being established at Lorient; (2) the naval disciplinary companies; (3) the colonial disciplinary companies; (4) the battalion of Senegal Tirailleurs, and the corps of native colonial infantry; (5) any such special corps as the requirements of the naval or colonial service may necessitate the formation of from time to time.

The marine infantry is recruited by means of a contingent, formed of those young men who draw the lowest numbers in the annual conscription, and also by voluntary enlistments. The effective of the corps at the present time numbers 16,000 men. The laws, decrees, and dispositions relating to the Army apply also to the marine troops; but

not until after they have received the approval of the Minister of Marine.

The tour of foreign service lasts for three years, excepting in the case of troops stationed in Senegal or in Cochin China, who only remain abroad for two years. The medical duties in the regiments of Marine Infantry are performed by the medical officers of the Navy.

5. *Naval Armourers.*

The corps of Naval Armourers was established in 1856 for service in the dockyards, in the colonies, on board ship, and in the naval divisions. It consists of chief armourers, who serve only on shore, of masters, second master, and quartermaster armourers. These are recruited by voluntary engagements, or by the admission of military artificers. The pay ranges from 350 to 1,150 frs., but in addition the men receive working, supplementary, and increased pay.

6. *Senegal Tirailleurs.*

This battalion, formed in 1857 for service in the French possessions in Senegal, is commanded by a Chief of Battalion, and consists of five companies, having each three officers taken from among those of the Marine Infantry. The staff includes, also, a Captain-Major, a Lieutenant-Treasurer, and a *medicin aide-major*. The corps is recruited by voluntary enlistments among the natives for a period of two years; the recruit receiving a bounty of 50 frs. The laws, decrees, and dispositions relating to discipline, pay, pensions, &c., in force in the Marine Infantry, apply also to the Senegal Tirailleurs.

7. *Senegal Spahis.*

This corps consists of a squadron of 8 officers and 102 men, taken from among the cavalry regiments of the metropolis. Natives are only admitted as volunteers.

8. *Corps of Cipahis.*

The Corps of Cipahis was originally formed in 1780, but was extensively reorganized in 1867. On its present footing it consists of two companies, having together an effective of 332 men, raised by voluntary enlistment among the natives. There are four native officers, but the remainder, namely, two Captains, two Lieutenants, and two Sub-Lieutenants, are taken from the Marine Infantry, the regulations of which corps apply also to the Cipahis. The two companies are distributed among various establishments in the French possessions in India; at Pondicherry, Karikal, Yanaon, Chandernagore, and Mahé.

9. *Disciplinary Company.*

The Disciplinary Company was organized in 1824 to supply a means of keeping under an exceptionally severe discipline certain men in the Navy, who, without committing such grave crimes as would lead to their being tried by court-martial, were nevertheless constantly and continually guilty of minor offences. Stationed originally at Lorient, the company was afterwards removed to the islands of St. Pierre and

Miguelon, whence again it was subsequently transferred to Guadeloupe. The dépôt of the company is quartered in the island of Oléron. The cadre consists of five officers, one of whom is Captain Commandant, and a certain number of non-commissioned officers and buglers. All of these are chosen from among corresponding ranks of the marine infantry, retaining their right to promotion in the latter corps.

10. *Colonial Disciplinary Corps.*

The Colonial Disciplinary Corps consists of two companies, the one stationed in Senegal, the other in Martinique and St. Pierre. The dépôt is at Oléron. The whole corps is under the command of a Chief of Battalion, the cadre of each company consisting of a Captain, three Lieutenants, and two Sub-Lieutenants, who, as well as the necessary non-commissioned officers and buglers, are supplied by the Marine Infantry.

11. *Warders of the Penal Establishments in the Colonies.*

The Corps of Warders was established in 1854, and is charged with the custody and direction of convicts transported to the Colonies. The warders are chosen from among retired non-commissioned officers of the Army or petty officers of the Navy, or, in default of a sufficient number of these being found willing to accept the appointment, from among men who have served in either the Army or Navy for not less than three years. On an average four warders are appointed for every hundred convicts. They are classed as chief warders of the first and second class, ranking with the guardians of artillery; as warders of the first class ranking with sergeant-majors, and as warders of the second and third class ranking with sergeants. Their pay varies from 1,600 to 4,000 francs. They are lodged at the expense of the State, and receive the same rations as the marine troops, being also in matters of discipline subject to the same regulations as this latter corps.

12. *Colonial Militia.*

Corps of Colonial Militia exist in the colonies of Réunion, Guadeloupe, Martinique, Guyane, and Senegal, and are placed under the orders of the respective Governors. Generally speaking, all colonists between the ages of 18 and 50 are liable to be called upon to serve in the militia.

VI. SPECIAL SERVICES.

1. *Maritime Engineers.*

The Officers of the Maritime or Naval Engineers in the French service are entrusted with the preparation of plans and designs, both for the construction and repair of men-of-war and of their machinery, and with the supervision of the execution of the approved projects, both in the public dockyards and in the shipbuilding and engineering yards of

private firms. They also superintend the reception, preservation, and preparation of the timber employed in naval architecture, and form part of the several technical Commissions and Committees of the Admiralty Council and of the Council of Works. They are recruited from among the pupils of the *Ecole Polytechnique*, passing, after leaving that establishment, through a special course of study at a School of Maritime Engineering at Cherbourg; but a sixth of the vacancies occurring among the sub-engineers of the third class are reserved for Masters (*Maîtres Entretenus*) of the Corps of Naval Constructors, who have held that rank for at least one year, and have passed a prescribed examination. The ranks in the corps of Maritime Engineers are as follows:—

Student, ranking with Cadet of the 1st class.			
Sub-Engineer of the 3rd class, ranking with <i>Enseigne de Vaisseau</i> .			
Sub-Engineer	2nd	„	Lieutenant of the 2nd class.
Sub-Engineer	1st	„	Lieutenant of the 1st class.
Engineer	2nd	„	Captain of Frigate.
Engineer	1st	„	Captain <i>de Vaisseau</i> .
Director of Naval Constructions, ranking after Rear-Admiral, but before Captain.			
Inspector-General, ranking after Rear-Admiral.			

Promotion in the lower ranks of the corps, up to Sub-Engineer of the 2nd class, takes place entirely by seniority. From Sub-Engineer of the 2nd class to Engineer of the 2nd class half the vacancies are filled up by seniority, half by selection. In the higher ranks advancement is entirely by selection. Every officer, however, must have served three years in the rank he holds before he can be promoted to the one next above, excepting in the case of Sub-Engineers of the 3rd class, who may be advanced into the 2nd class after holding the first-named rank for two years.

The number and pay of the officers of the Maritime Engineers is at present fixed as follows:—

		Pay on shore.	Pay at sea.
1 Inspector-General	.....	14,000 frs.	
1 Director of Naval Constructions	.....	12,000 „	
5 Directors	„ „ 1st class	12,000 „	
5 Directors	„ „ 2nd „	10,000 „	
20 Engineers, 1st class	.....	6,500 „	7,600 frs.
20 Engineers, 2nd „	.....	5,000 „	6,000 „
26 Sub-Engineers, 1st class	.....	3,000 „	3,600 „
26 Sub-Engineers, 2nd „	.....	3,500 „	3,000 „
14 Sub-Engineers, 3rd „	.....	2,000 „	2,400 „
7 Pupils	.....	1,600 „	

2. *Engineer Hydrographers*.

The Engineer Hydrographers are entrusted with the construction

and publication of charts, the revision of the sailing directions, the compilation and publication of scientific works bearing on nautical matters, the arrangement and issue of tide, magnetic, and meteorological tables, the examination and utilization of nautical and scientific documents sent in to the dépôt of charts; and, finally, with the acquisition, repair, &c., of the nautical instruments used on board men-of-war. The officers of the corps may be attached to hydrographic missions on the French coast or abroad, and may be sent to any naval station to execute hydrographic or scientific work.

The various ranks in the corps are as follows:—

Engineer Hydrographer Pupil, ranking with Cadet of 1st class.

Sub-Engineer Hydrographer, 3rd class, ranking with *Éuseigne de Vaisseau*.

Sub-Engineer Hydrographer, 2nd and 1st class, ranking with Lieutenant.

Engineer Hydrographer, 2nd class, ranking with Captain of Frigate.

Engineer Hydrographer, 1st class, ranking with Captain *de Vaisseau*.

Chief Engineer Hydrographer, ranking after a Rear-Admiral, but before a Captain.

The Hydrographer Pupils are taken from among the pupils of the *École Polytechnique*, and, after spending two years at sea, are, as vacancies occur, nominated Sub-Engineer Hydrographers of the 3rd class. The regulations regarding promotion are the same as in the Maritime Engineers, the following being the effective and pay of the corps as at present established:—

	Pay on shore.	Pay at sea.
1 Chief Engineer Hydrographer.....	10,000 frs.	
3 Engineer Hydrographers, 1st class....	6,500 „	7,600 frs.
3 Engineer Hydrographers, 2nd „....	5,000 „	6,000 „
2 Sub-Engineer Hydrographers, 1st class	3,000 „	3,600 „
2 Sub-Engineer Hydrographers, 2nd „	2,500 „	3,000 „
2 Sub-Engineer Hydrographers, 3rd „	2,000 „	2,400 „
Hydrographer Pupils	1,600	

3. Commissariat Officers.

The naval commissariat service is charged with numerous and complex duties. It is entrusted with the provisioning and supply of the several services; it contracts for all that is required; it verifies the articles sent in and gives receipts for them; it musters all the *personnel* paid under the naval estimates; it keeps the accounts on board ships; and it performs all administrative duties in the hospitals and prisons connected with the Navy.

The officers of the commissariat are recruited from among *Élèves-commissaires*, who are nominated by the Minister of Marine. Candidates for admission must be provided with the diploma *de licencié en droit*, or, failing that, with the diploma of *bachelier ès-lettres*, and are

further subjected to a special examination on entrance. The approved candidates are sent to one of the naval ports, where they undergo a course of instruction in administrative duties. In the case of those who have the higher diploma this period of study lasts for two years only; but the *bacheliers ès-lettres* remain under instruction for a third year. At the expiration of their course the pupils are again examined, those who pass satisfactorily being given the rank of *Aide-commissaire*. Eight vacancies among the *Aides-commissaires* are, however, reserved each year for other candidates, namely, two for *Enseignes*, who have been selected by the Minister; two for pupils of the *Ecole Polytechnique*, who are pronounced fit for admission into the public service; and four for clerks in the commissariat service (*Commissaires du Commissariat*), who must be between the ages of 25 and 35, must have two years' service as clerks, must be *bacheliers ès-lettres* or *èsciences*, and must have passed an examination similar to that undergone by the *Elèves-commissaires*.

The ranks in the commissariat service are as follows:—

Elève-commissaire, having no relative rank.

Aide-commissaire, ranking with *Enseigne de Vaisseau*.

Sub-Commissary, 2nd class, ranking with Lieutenant, 2nd class.

Sub-Commissary, 1st " " 1st "

Commissaire-Adjoint, ranking with former Captain of Corvette or Chief of Battalion.

Commissary, ranking with Captain *de Vaisseau*.

Commissaries-General, 1st and 2nd class, ranking after Rear-Admirals but before Captains.

Promotion in the corps is governed by the following regulations:— Two-thirds of four-fifths of the vacancies in the rank of Sub-Commissary are given to the *Aide-Commissaries* by seniority, the other third by selection. The remaining fifth of the vacancies are given to Lieutenants in the Navy who are successful at a competitive examination. All vacancies in the rank of *Commissaire-Adjoint* are given to Sub-Commissaries, one-half according to seniority, the other by selection. The vacancies in the ranks of Commissaries and Commissaries-General are given by selection to the *Commissaries-Adjoint* and Commissaries respectively. No officer in the Commissariat service can, however, be promoted until he has served three years in the rank he holds; but service at sea or in the colonies counts for one and a half its actual length. At sea the administrative service is directed by officers of the following rank:—In a fleet, by a Commissary-General or Commissary; in a squadron, by a Commissary-*Adjoint*; in a naval division, placed under the orders of a "General Officer" Commanding-in-Chief, also by a Commissary-*Adjoint*. Whilst employed afloat officers of the Commissariat take temporarily the titles of Commissary of the Fleet, Commissary of the Squadron, Commissary of Naval Division, and Administrative Officer on board separate ships.

The number and pay of Commissariat Officers is at present fixed as follows:—

	Pay on shore.	Pay at sea.
5 Commissaries-General, 1st class..	12,000 frs.	14,000 frs.
4 Commissaries-General, 2nd , ..	10,000 "	12,000 "
26 Commissaries	6,500 "	7,600 "
50 Commissaries- <i>Adjoints</i>	4,500 "	4,500 "
90 Sub-Commissaries, 1st class	3,000 "	3,600 "
90 Sub-Commissaries, 2nd ,	2,500 "	3,000 "
150 <i>Aides</i> -Commissaries	2,000 "	2,400 "
30 Pupils	1,600 "	

4. Commissariat Clerks.

Commissariat clerks are civilian *employés*, appointed to assist the officers of the Commissariat in their clerical work. They are appointed from among the inferior officers of the Navy, or non-commissioned officers of the Army, who have completed their period of service, and as has been shown above, they are eligible, under certain conditions, for appointments in the Commissariat itself.

5. Chaplains of the Navy.

According to the estimates for the present year (1877), the following is the effective and pay of the Chaplains of the French Navy:—

	Pay on shore.	Pay at sea.
1 Chaplain-in-Chief { maximum 12,000 frs.		
minimum 10,000 "		
4 Superior Chaplains	4,500 "	5,400 frs.
23 Chaplains, 1st class	3,000 "	3,000 "
23 Chaplains, 2nd ,	2,500 "	3,000 "

The Chaplain-in-Chief ranks with a Commissary-General, the Superior Chaplains with Commissaries-*Adjoints*, the remaining Chaplains with Sub-Commissaries, according to their class.

The Chaplain-in-Chief is nominated by the Chief of the State; Chaplains of the other ranks are selected by the Minister of Marine from among those of the ranks immediately below, upon the proposition of the Chaplain-in-Chief. A Chaplain is embarked on board every man-of-war flying the flag of an Admiral or the pennant of a Chief of Naval Division, also on board every vessel destined for active service, or about to proceed on a distant voyage, or on any exceptional mission. Superior Chaplains can only be embarked on board ships flying the flag of an Admiral Commanding-in-Chief; other Chaplains are embarked by roster.

Naval Chaplains serving on shore receive their spiritual authority and power from the Bishop of the diocese in which is situated the port or naval establishment in which they may happen to be doing duty. Chaplains embarked on board ship, on the other hand, receive their spiritual authority and power from the Chaplain-in-Chief of the Navy by virtue of a special dispensation from the Holy See. Chaplains on disembarking remain at the disposition of the Maritime Prefect, who details them, with the approval of the ecclesiastical autho-

rities of the diocese and of the Chaplain-in-Chief, to duties in the naval establishments.

6. Medical Service.

The grades in the Medical Service of the French Navy, as established by an Imperial Decree dated the 25th of April, 1870, are as follows:—

- Aide-médecin*, ranking with Cadet of the 1st class.
- Surgeon of the 2nd class, ranking with *Enseigne*.
- Surgeon of the 1st class, ranking with Lieutenant.
- Principal Surgeon and Surgeon Professor, ranking with the former Captain of Corvette or *Commissary-Adjoint*.
- Surgeon-in-Chief, ranking with Captain *de Vaisseau*.
- Surgeon-Inspector, ranking after Rear-Admirals, but before Captains.
- Inspector-General, ranking with Rear-Admiral.

In the Apothecary Service (Service Pharmaceutique).

- Aide-Apothecary, ranking with Cadet, 1st class.
- Apothecary of the 2nd class, ranking with *Enseigne*.
- Apothecary of the 1st class, ranking with Lieutenant.
- Principal Apothecary and Apothecary Professor, ranking with former Captain of Corvette or *Commissaire-Adjoint*.
- Apothecary-in-Chief, ranking with Captain.
- Apothecary Inspector, ranking after Rear-Admirals, but before Captains.

The following is the cadre of the Medical Service, as laid down in the estimates for the present year:—

	Pay at sea.	Pay on shore.	Pay in the Colonies.
1 Inspector-General.....	14,000 frs.		
3 Directors of the Medical Service, 1st class	12,200 "		
4 Directors of the Medical Service, 2nd class	10,000 "		
16 Surgeons-in-Chief	6,500 "	7,600 frs.	9,000 frs.
9 Surgeons Professors	4,500 "	..	6,500 "
34 Principal Surgeons	4,500 "	5,400 "	6,600 "
161 Surgeons, 1st class	3,000 "	3,600 "	5,250 "
163 Surgeons, 2nd	2,000 "	2,400 "	4,000 "
150 <i>Aides-Médecins</i>	1,600 "	1,800 "	2,800 "
4 Apothecaries-in-Chief	6,500 "	7,600 "	9,000 "
6 Apothecary Professors	4,500 "	..	6,500 "
2 Principal Apothecaries	4,500 "	5,400 "	6,500 "
12 Apothecaries, 1st class.....	3,000 "	3,600 "	5,250 "
16 Apothecaries, 2nd	2,000 "	2,400 "	4,000 "
19 Aides-Apothecaries	1,600 "	1,800 "	2,800 "

Surgeons and apothecaries destined for the several branches of the naval service receive their medical education in the schools of naval

medicine established in the ports of Brest, Rochefort, and Toulon. *Aides-médecins* and aides-apothecaries, surgeons and apothecaries of the second and first class, surgeons and apothecary professors, are nominated by examination. Surgeons and apothecaries of the first class are nominated by examination and by selection; but the nominations by selection are not to exceed one-half of the vacancies, and only surgeons and apothecaries of the second class, who have satisfactorily passed a prescribed examination, may be selected. Principal surgeons and apothecaries are nominated one-half by seniority, the other by selection from among the names on a list for promotion prepared by the Admiralty Council. Advancement to the higher ranks takes place altogether by selection.

At sea the medical service is directed in a fleet by a Surgeon-in-Chief; in a squadron, under the orders of a Vice-Admiral Commanding-in-Chief, by a Surgeon-in-Chief or a Principal Surgeon; in a naval division commanded by a Vice- or a Rear-Admiral Commanding-in-Chief, by a Principal Surgeon; on board every vessel flying the flag of an Admiral second in command, by a Principal Surgeon; in a naval division placed under the command of a Captain, by a Surgeon of the first class provided with a commission of Surgeon of Division; on board every other vessel which carries a doctor, by a Surgeon of the first or second class or by an *aide-médecin*, according to the complement of the vessel. Officers of the medical department assume, according to their position, the temporary titles of Surgeon-in-Chief of the Fleet, Surgeon-in-Chief or Principal Surgeon of the Squadron, Principal Surgeon or Surgeon of Division and Surgeon-Major. On shore, surgeons of the first and second class are attached, and do duty with the several corps of the Navy, taking, according to their rank, the title and exercising the functions of Surgeon-Major or Surgeon Aide-Major. Medical appointments in the colonies are given to those naval surgeons who apply for them, or to those who have passed special examinations in the schools. When, however, a vacancy occurs in the colonial service, and no candidate for it presents himself, the junior officer having the necessary rank among those who are first on the embarkation lists in the five naval ports is ordered to fill it; being relieved, however, at the expiration of two years.

7. Hospital Attendants.

The Corps of Hospital Attendants is of the following strength:—

Master Hospital Attendant	6
Second-master Hospital Attendant ..	42
Quarter-master Hospital Attendant..	72
Sailor Hospital Attendant (1st class)	152
" " " " (2nd class) .	153

On board ship the hospital attendants are, so far as their duties are concerned, under the direct orders of the senior medical Officer, and on shore under those of the chief surgeon of the hospital to which they are attached.

8. Inspectors of Administrative Services.

This corps, created to assure the regular working of all branches of

the administrative service, consists at present of the following Officers:—

1 Inspector-in-Chief	20,000	frs.
2 Inspectors-in-Chief (1st class)	12,000	"
3 Inspectors-in-Chief (2nd class).....	10,000	"
12 Inspectors	6,500	"
12 Inspectors-Adjoints.....	4,500	"

With regard to relative rank, the Inspector-Adjoints rank with the formerly existing Captain of Corvette, or Chief of Battalion; the Inspectors with Captain *de vaisseau*; Inspectors of the 1st and 2nd class after Rear-Admirals, but before Captains. The ranks of the Inspectors-Adjoints are recruited by competition among naval Lieutenants, Captains of Artillery, naval Sub-Engineers of the 1st and 2nd class, and Sub-Commissaries. Three years' service in each rank is required before an Officer can be advanced to the grade next above the one he holds.

The other special services in the French Navy are—

9. Engineers of roads and bridges attached to the naval service.
10. Professors and examiners of the naval school.
11. Examiners and professors of hydrography.
12. Storekeepers.
13. Magazine men of the fleet.

VII. RECRUITMENT OF THE FRENCH NAVY.

The *personnel* of the French Navy (officers naturally excepted) is recruited in three ways. First, by calling in men belonging to the *inscription maritime*; secondly, by means of voluntary enlistments; and, thirdly, in default of a sufficient number being obtained from either or both of these first two sources, by drafting into it a contingent of the men obtained by the annual conscription (*contingent du recrutement affecté à l'armée de mer*). This contingent is composed of the young men who have drawn the lowest numbers in the cantonnal conscription.

Maritime Inscription.

Every young man who has made two foreign voyages (*voyages au long cours*) either on board a state vessel or a merchant ship, or who has been leading a seafaring life for eighteen months, or who has been employed in fishing for two years, and who declares an intention of continuing in the vocation of a sailor or fisherman, is entered, on attaining the age of eighteen, as a sailor in the maritime inscription, and is liable to be called upon to serve in the fleet; and, on completing his twentieth year, every inscribed sailor is called into service. During the month in which he attains his twentieth year, or during the month which succeeds his return to France, should he be abroad when he comes of age, he is bound to present himself before a Commissaire of the Maritime Conscription. By this latter he is sent to the chief port of an arrondissement and there entered in one of the divisions of seamen. If, at the age of eighteen, he is declared fit for service, he may anticipate his time of being called in. From the age of eighteen the *inscrit*

maritime performs his service in two periods. During the first of these, which lasts for five years, he may be granted, when in France, a renewable furlough ; receiving no pay, but at liberty to devote himself to any kind of navigation. After this period he remains for two years more in the same state of renewable furlough. The time thus passed is counted as service rendered to the State (*service à l'Etat*) by every *inscrit*, who engages only to employ himself in coasting vessels or in coast fishery. Finally, after the expiration of this second period the *inscrit* can only be called in by a special decree, and in case of an extraordinary armament. After the first three years of service the sailor who has not been sent on furlough has a right to an increase of 20 centimes a day to his pay. The men first called in for service in the fleet are those who have not as yet rendered any service to the State ; then those who have rendered the least service, and, in the event of equal length of service, those who have been for the longest time on leave. Exemptions are permitted in the case of the eldest brother of a family of orphans ; in the case of men who have a brother already serving ; in the case of only sons ; or in the case of the eldest son, or grandson, if the son is not alive, of a widow or of a blind man, or of a man who has passed his seventieth year. Exemptions must, however, be granted in each individual case by the Minister of Marine at the instance of the Maritime Prefect.

Certain advantages are reserved by the State in the *inscrits*. They alone can engage in the coast fisheries or in maritime navigation. During the time they are serving and for forty days after they return to their homes, troops cannot be billeted in their houses. They are admitted gratuitously to the course of hydrography. When actually serving they may travel by railway at a fourth of the usual fare ; and when on renewable furlough they can claim the same privilege when called in or when travelling in pursuance of an order. They are admitted free to the hospitals if they fall sick within forty days of the date of their proceeding on leave ; and, finally, by paying a small subscription, which never exceeds three per cent. of his pay, the *inscrit* becomes entitled on attaining the age of fifty, and after leading a seafaring life for twenty-five years, to a pension (called *demi-solde*) whatever may be the length of service he has rendered to the State. His widow and orphans also receive a small pension.

Enlistments and Re-engagements.

The minimum age at which a man can enlist into the navy is at present fixed at eighteen ; the right of entering at sixteen being reserved to pupils of the *Ecole des mousses* and to those in favour of whom the Minister of Marine may give a special decision. The maximum age for men who have not rendered any service to the State is fixed at twenty-four years ; but it is extended to thirty years for musicians, stokers, carpenters, sailmakers, and caulkers, provided they can make up at least five years' former service since attaining the age of sixteen.

Re-engagements must be made for three, four, or five years. No conditions as to age or service are laid down, excepting that no quartermaster or sailor is allowed to re-engage, if at the expiration of the

period of his re-engagement he would be more than fifty years of age, nor any man in a higher rating if he would on the expiration of his service exceed fifty-five years of age. No one, however, is allowed to re-engage until he has been examined by a commission specially appointed for the purpose in each of the naval ports.

Ratings and Promotion.

The first rating among the seamen of the Fleet comprises the novices (*novices*), naval apprentices (*apprentis marins*) and sailors; these latter being divided into three classes. Above them come the quarter-masters, second-masters, masters and first-masters; below them boys, known as *mousses*.

Novices.

Under this denomination are included seamen who, being above the age of sixteen, do not as yet fulfil the conditions of age and service necessary for the rating of sailor, and are only bound to the service of the State by being provisionally entered in the maritime inscription; their inscription becoming definite so soon as they shall have fulfilled the said conditions, provided they declare their intention of continuing a sea-faring life. Every seaman, however, entering the service as a novice is bound to remain in it for at least two years.

Naval Apprentices (apprentis marins).

Young men joining the Navy from the *Ecole des mousses*, and who subscribe the necessary engagement, men who voluntarily enlist for five years, and men drafted into the service as part of the contingent raised by conscription, and who do not satisfy the conditions necessary for at once obtaining the rating of sailor of the third class, may be admitted as naval apprentices, and are embarked on board the vessel serving as the dépôt for the inscription.

Quartermasters and Higher Ratings.

No one can be entered as a sailor of the third class unless he is eighteen years of age and has been embarked for twelve months, if he be one of those recruited by conscription; or has made two foreign voyages or has been at sea for eighteen months, or has been employed for two years in the coast fishery if he belongs to the maritime inscription. To be nominated a sailor of the second class a man must have served for six months as a sailor of the third class, or have rendered four years' service to the State, dating from the age of eighteen, during which time he must have been on foreign or long coast voyages; and to be promoted to a sailor of the first class a man must have served for six months as a sailor of the second class. Similarly, before a man can be advanced to the rating of quartermaster, he must have served as a sailor of any class for six months. To become a second-master, he must have served as quartermaster for at least six months on board an armed vessel; and before he can attain the rank of first-master or master, a man must have served for at least six months as a second-master on board a man-of-war having a complement of 250

men, or have discharged for the same period the duties of acting master on board an armed vessel having a crew of 150 men.

Second-masters, masters, first-masters, sergeant-majors, captain and sergeants of arms are known as inferior Officers of the Navy (*Officers mariniers*), and are the Warrant Officers of the Fleet.

The Reserve of the French Navy.

The whole seaboard of France is divided as has been shown, into five maritime arrondissements, and in these the naval forces are concentrated at five chief ports. It is at these ports that the recruits for the Navy, derived from the three sources, receive their first naval education, and it is thither also that the men, who have passed through their five years of active service, have to repair if the naval reserves are called in. In each port there is an office, where all business connected with the reservists is transacted, and in which double lists are kept with the name, rating, number, and residence of each man. When the order is given by the Minister of Marine to call in the reserves, one of these lists is sent to the Commandant of the recruiting dépôt of the district in which the reservist resides, and the order to join is forwarded by the former to the latter through the gendarmerie.

VIII. THE MAN-OF-WAR.

The ultimate objective of all the organization which has been briefly described in the foregoing, is the production and equipment of the man-of-war.

In the first place it is necessary to construct the vessel. The Admiralty Council determine at the outset the number and class of ships required for the Navy. The requirements to be fulfilled and the limit of expense which may be incurred being specified, the Officers of the Maritime Engineers are invited to compete in drawing up designs for the vessels. The plans sent in are examined in Paris by the Council of Works and the Inspection General of Maritime Engineering. If the Minister approves of them, and decides that they shall be carried out, the accepted designs are sent to one of the dock-yards, with orders for the work to be proceeded with; or the construction may be entrusted to a private firm, the Maritime Engineers in that case supervising the progress of the work. Formerly, when ships were built of wood, fifteen or twenty years was required for their completion; but now that iron is employed, five years is sufficient for the construction of a vessel, since while, for instance, the hull is being built at Toulon or in a private yard, the armour is being forged in civilian workshops, the machinery is being made at Indret, or by an engineering firm, and the artillery is being prepared at Ruelle or Nevers. When all is finished, the trials are proceeded with, and if the result is satisfactory, the ship may be at once commissioned, or placed in one or other of the three categories of the reserve.

When a man-of-war is commissioned, the Commandant is nominated by the Chief of the State. If he be a Captain *de vaisseau* he has the right to select his second in command and one of his Lieu-

tenants. If he be a Captain of Frigate or a Lieutenant in command he can only choose one Officer. The others are embarked by the roster, as are also the Warrant Officers of the ship. Petty Officers and men of the several special branches of the service are also embarked from the divisions at the ports; that is to say, a certain number of seamen gunners, of small-arm men, of stokers, of artificers, &c., are sent on board each ship commissioned, so that the Captain on joining finds himself surrounded by men fully acquainted with and competent to discharge their respective duties. With regard to *matériel*, the necessary stores of all kinds are drawn from the dockyard, and when the equipment is complete, a Commission, nominated by the Maritime Prefect, and presided over by the Major-General of the Port, proceeds on board, and in the presence of the staff of the ship satisfies itself that all the regulations relative to the armament, fitting out, &c., of the vessel, have been complied with. The man-of-war thus manned and armed is taken out of the arsenal. The Captain hoists the national ensign, the distinctive marks of his rank and position, and his number. Thenceforth he is invested with the full powers pertaining to the Commanding Officer of a vessel of State, and is responsible for the discipline and instruction of his crew, for the maintenance in good order of the ship and men committed to his charge, and for the protection of his fellow countrymen in foreign parts. Such are his duties. His second in command is charged with the detail of the work and with the superintendence of the police duties of the ship. He receives and transmits the orders of the Captain, superintends their execution, and informs his senior officer of all that goes on board the ship. Every officer of the vessel has his post and his special duties, such as instruction of the small-arm men, seamen gunners, charge of machinery, &c. Each in turn keeps watch. The Officer of the Watch alone gives the orders for carrying on the manoeuvres of the ship, unless the Captain or second in command assume the command. The Master of Manceuvre of the Watch (*Maitre de Manceuvre de Quart*) repeats the orders by means of a pipe, and exercises an incessant authority over all the crew. With him, under the officers, are placed the other masters in charge (*Maitres chargés*) of gunnery, captains of arms, artificers, carpenters, caulkers, armourers, &c., who exercise an especial supervision over the men belonging to their respective departments. Finally come the Chaplain, one or more Surgeons, and the Administrative Officers, the latter of whom, with the Captain and second in command, compose the Administrative Council of the ship. This Council directs all administrative details, audits the accounts, sanctions the payment of accounts, and can in certain cases be held pecuniarily responsible.

On leaving France the officers receive pay in advance, the amount depending upon the destination of the vessel. The inferior officers and sailors have not this privilege. Abroad both officers and men receive the whole of their pay, the funds necessary for the purpose, as well as for defraying other current expenses, being obtained by drawing bills at one month's sight on the Accountant of the Navy, payable at the Treasury. The bills must be signed by three officers

at least, one of them being the Captain. In a fleet two signatures are sufficient, namely, those of the Commander-in-Chief and of the Commissary.

In a vessel of war, the Captain has undoubtedly as heavy a responsibility as can devolve upon any one man. Not only has he to look after the safe conduct of his ship, the health, instruction, and discipline of his crew, to supervise the execution of the administrative duties, but he has also to occupy himself with political questions, since his vessel represents his country, and at any moment the difficult and delicate task of maintaining the honour of its flag may devolve upon him. To form and educate men for this work, to organize crews worthy of their Captains, to send to sea and maintain afloat men-of-war, such is the object of naval administration and organization. Two things are indispensable for its attainment—time and money. Nothing can be improvised in a navy, and therefore liberal but judicious expenditure will frequently be in the end the truest economy. For if money fails when there is time, time in turn may be wanting when money comes. The most strenuous efforts, the greatest sacrifices, may be of no avail, because they are made too late.

NOTICES OF BOOKS.

Kriegsgeschichtliche Studien nach der applicatorischen Methode. Von J. VON VERDY DU VENOIS. 1st Vol., *Taktische Details aus der Schlacht von Custoza.* Mittler, Berlin. Pamphlet. Price about 3s.

In the preface to this, his latest work, General Verdy du Vernois points out two ways of utilizing military history for the study of war.

1. Critical consideration of military operations.

The author admits the many advantages of this method, but tells us that the more he sees of real war, the less confidence he has in military critics, especially where they impute blame. Orders to large bodies of troops, he says, usually emanate from men who have had experience in war, and know what they are about: they have given their orders in accordance with what they know of the general state of affairs. Of this, the reader of history can hardly ever be completely aware; so that, in the words of the author, "the assertions of the critics so constantly recurring, 'the general must have known this or that,' or 'he must, under these circumstances, say to himself,' have frequently no foundation in fact." It may, indeed, be doubted whether the criticisms on the campaigns of Napoleon and Frederick the Great, which students of military history listen to and compose, do very much towards extending their knowledge of the conduct of modern war.

2. The other method, which the author prefers, is, "to use military history as the groundwork for self-instruction." "Select," he says, "from any military work a given situation; put yourself in the place of the commander, and make your dispositions;

then compare them with those actually made. When you find a difference, endeavour to discover its cause, and to decide which course would be preferable."

To illustrate his system, the author gives an account of the march of a division to the field of battle, its deployment for battle, and its conduct during the fight. His plan is as follows: He takes an account of some military operation, defines the situation as far as it can be ascertained from the materials at hand; he then propounds a series of questions concerning the further action of the troops which arise from the situation. Having solved these questions, he refers to the text, relates what actually occurred, and institutes a comparison between the way in which he would propose to act under the circumstances, and what actually was done. Should there be a difference, the author proceeds to give explanations, and his reasons for preferring one course to the other. For the present study, the author has chosen the part taken in the battle of Custoza by the Reserve Infantry Division of the Austrian army, a portion of the 5th Austrian Corps, and a detachment which sallied out from Mantua; while, on the Italian side, were engaged the three divisions of the 1st Corps. For a historical account of the action, the author relies *solely* on the Austrian Staff account of the war of 1866, 2nd vol. In the first part of his book, Verdy du Vernois works with an imaginary division organized on the Prussian system, and incidentally brings into strong relief the simplicity of this organization as compared with the heterogeneous composition of the actual Reserve Division.

The author's remarks on the conduct of a march, the behaviour of an advanced guard coming unexpectedly on an enemy, and numerous other points, are of great interest; but, omitting details as far as possible, it is his system only which it is desired here to describe. An instance where the orders given by the author to his hypothetical division are at variance with the measures actually adopted by the Austrian general, will perhaps furnish the best illustration.

The division, consisting of two brigades, arrives before the town of Castel Novo, and, to carry out the instructions received from higher authority, it is advisable that one brigade be pushed on through the town, the other brigade remaining on the hither side of it. These brigades have marched from different points, and Verdy du Vernois naturally sends on the brigade which has made the shortest march and is the first to arrive. The Austrian general, however, did not do this, and the author, instead of taking for granted he must be wrong, discusses the matter in the following strain:—"The order directing the Weimar Brigade to remain north of Castel Novo while the Brigade Benko was pushed through the town to the south of it, appears strange. One must say to oneself, the Brigade Weimar has made the shortest march, and was the first to arrive at Castel Novo; it would surely be the most natural and desirable course to send on this brigade to take up a position beyond the town: such would certainly be the quickest way of accomplishing the object in view. This plan is so natural, that it is impossible to believe the commander of the division can have failed to think of it. He must, then, have had some special reason for ordering matters otherwise: our business is not to condemn his arrangements, but to strive to discover what can have led to them."

"Meditating on the matter, I thought of again referring to the composition of the two brigades, and I now came on what appeared to throw light upon the general's reasons for his decision. The Brigade Benko was the stronger of the two; it consisted of seven battalions and one battery (heavy)—6,145 combatants; whereas the Brigade Weimar was composed of only five and five-sixths battalions and one battery—5,167 combatants.

"The situation required that the division should be as strong as possible in the first line, and it was desirable that the stronger brigade, which was, moreover, more uniformly organized, and had a heavy battery, should go to the front. Whether this was the real motive or not must remain undecided: at any rate, should there be further reasons for this decision, they must be sought for in some peculiarity in the inner constitution of the body of troops. These special conditions most frequently escape the notice of the reader of military history, and it would be well for him always to bear in mind the possibility of their existence when he can find no other explanation of some act; for, in truth, we have not only to reckon with the number of battalions, squadrons, and combatants, but we must also bear in mind their organization and inner elements. Also personal considerations, the capacity of

commanders, quality of troops, and accidents,¹ have great influence on the course of events."

The author's remarks at the end of the first part still further illustrate his system: "The lessons and reflections, so far (some 40 pages), have been derived from one and a-half pages of the Austrian Staff work. Much more might, however, be extracted from these pages. Small changes in the numbers of troops engaged would necessitate different dispositions. Such alterations would become necessary, if, for instance, we suppose a regiment detached for special duty, or that the division received a battalion of Rifles, or had the corps Artillery or a Cavalry brigade attached to it. Interesting, too, would be the considerations, if one supposed that the right wing column came first on the enemy, or that the enemy had already crowned the Monte Ericol.² The operations described might also be worked into the shape of orders and reports."

Having detailed the author's system, a few remarks on what would appear to be the weak points of it may not be out of place. As a system of self-instruction it may be deemed weak in the respect that the setting of problems is as difficult as the solving of them, and a student requires some one of experience at hand to set him right.

One is also struck by the poverty of the materials used by the author for this study, viz., a few pages of the Austrian Staff work, and a map on a scale of about an inch to a mile. As regards the latter, the author frequently allows its insufficiency, using the expression "as far as can be judged from the map." It is difficult to believe he could not have obtained, had he wished it, some Italian account of the action which would have thrown more light on it, also a map on a larger scale; and it may be presumed that he has deliberately worked with scant materials to illustrate his system, which is one of *mental training*, the problems being solved on the situation as far as it can be ascertained.

As regards the inability of students to set themselves problems, it must be remembered that military problems are not complex and difficult calculations, they merely require common sense and a full knowledge of the situation. The real difficulty lies in making a rapid decision when unused to weighing contingencies and grasping a whole situation. The mind, like the body, works, to a certain extent, automatically, and the habit of solving problems in the study cannot fail to give increased decision and confidence in the field. Few who have read his work carefully will differ with the author where he says, "I conclude with an expression of my conviction that, if anyone in the course of a single winter will occupy himself with treating a single volume of military history on the principle I advocate, he will infallibly admit the advantages of my method when he finds with what ease, after a short time, he can set himself problems and solve them."

Studies in Troop Leading. By Col. J. VON VERDY DU VENOIS. Translated from the German by Lt. Hildyard, 71st Highland Light Infantry. Parts I and II. H. King and Co., Cornhill, 1872. Price 7s. Size, 8 $\frac{1}{4}$ " x 5 $\frac{1}{4}$ " x $\frac{3}{4}$ ". Weight, 1lb.

Ditto ditto, parts III and IV, 1877. W. Mitchell, Charing Cross. Price, 7s. 6d. Same size and weight.

So much misapprehension prevails with regard to the character of this invaluable work, a work which ought to be in the hands of every regimental officer, that it is desirable to afford some information as to its scope and object. Much of the misapprehension has arisen from the title of the work. Capt. Hildyard has undoubtedly correctly rendered the original "Truppen Fuhrung" as "Troop Leading;" but there is in the cavalry an individual whose duty it is to direct the movements of a troop of that arm, and who is called the "Troop-Leader," and we have met more than one

¹ As in this battle of Custoza, where a single Austrian squadron dispersed an Infantry brigade and the staff of two generals.

² Variations from what actually did occur.

officer who imagined that Col. Verdy du Vernois' admirable work applied exclusively to one branch of the Service. This idea is so far from the truth, that every branch, not only combatant but non-combatant, may derive valuable lessons from the teaching of this officer.

As there are probably many who have not read the first and second parts of the work, which were published in an English dress, first in an unauthorized form, and subsequently by Capt. Hildyard in an authorized form four or five years since, we purpose giving a short account of the scope of the book, and such a summary of the first part as will enable officers who do not possess the first volume to study this one with complete understanding of the theme of the work.

The only reverse sustained by the Prussian arms in 1866 was on the 27th of April of that year at Trautenau. On that day the 1st Corps d'Armee started in two columns from Königshain and Schomberg respectively; they were to unite at Parschnitz, after passing through the mountains, and were to rest for two hours under the protection of the advanced guard, which was to occupy Trautenau; the advanced guard was afterwards to reach Arnau. These orders were very imperfectly carried out, and the result was, that after some hours' severe fighting, the Army Corps retreated, and between one and three o'clock on the morning of the 28th reached, very much exhausted, the bivouacs it had quitted the previous morning on the far side of the hill. Colonel Verdy du Vernois, with a boldness rarely met with, takes for his text "The Situation of the 1st Army Corps on the 26th June, 1866," and then proceeds to describe in minute detail the proceedings by which, in imagination, the orders were carried to a successful issue, confining, however, his remarks almost entirely to the working of the 2nd Infantry Division, of which the order de bataille is as follows:—

ORDRE DE BATAILLE

Of the 2nd Infantry Division and the 1st Cavalry Brigade.

2nd Infantry Division.

Officer Commanding, Lieut.-Gen. A. Officer of the Staff, Major X.

3rd Infantry Brigade, Major-General B. 4th Infantry Brigade, Major-General C.

1st Regiment, Colonel D. 3rd Regiment, Colonel F.

2nd Regiment, Colonel E. 4th Regiment, Colonel G.

1st Hussars, Lieutenant-Colonel H. 1st Foot Division, 1st Artillery Regiment.

1st and 2nd Heavy, 1st and 2nd Light Batteries.

1st Company 1st Engineer Battalion, Captain K. Sanitary Detachment.

1st Cavalry Brigade, Major-General L.

1st Uhlans, Colonel N. 1st Cuirassiers, Lieutenant-Colonel M.

1st Mounted Battery, 1st Artillery Regiment.

Detached. 2nd Uhlans to the 1st Infantry Division.

Temporarily attached to the 2nd Infantry Division, 2nd Field Hospital.

The order in which the Colonel treats the subject is as follows:—A description of the general situation, and of the situation of the 2nd Infantry Division is followed by the "Information possessed by the Divisional Commander regarding the enemy, his own troops, and the general design." To this succeeds "the reconnaissance of the 26th June," and "the Divisional Order issued to carry out the Corps Order for the 27th June;" then follow "Comments on the Divisional Order." In similar fashion "The advance of the 2nd Division on Parschnitz," "The rendezvous at Parschnitz," "The expulsion of the enemy from Trautenau," "The conduct of the Commander and of the General Staff Officer," "The proceedings of the 3rd Infantry Brigade," of "The Cavalry Regiment," and of "The Artillery" are first described in detail, and then commented upon minutely and very clearly. The first volume closes here with the state of the action at 11.30 a.m.

The proceedings narrated in the second volume commence at 11.30 a.m. The 2nd Division have driven the enemy out of Trautenau, and is in position to the south-east of the town; and as the numbers indicating the Infantry are not marked very clearly on the plan, we give them here:—The 1st and 2nd Battalions of the 1st and 2nd Regiments in mass of battalion columns, 2nd Battalions in front, 1st Regiment on the right, on the west of the hill marked 460; the 9th Company, 1st Regiment, is in close order, and the 12th Company, 1st Regiment, in extended order

in Hohenbrück; the 10th Company is on the edge of a small wood to the eastward; the 11th Company is detached to the Raussnitz Valley which lies outside the plan to the east of Trautnau. To the left are the three companies present of the Fusilier Battalion, 2nd Regiment, two in front, one in reserve.

Of the 4th Brigade the 1st and 2nd Battalions of the 3rd and 4th Regiments respectively are on the west and east sides of the little wood north-east of the hill marked 460. The 10th and 11th Companies of the 3rd Regiment are in the wood on the side of hill 460. The 12th is in reserve in rear joined by the 9th Company, only a little over two subdivisions strong, as a part of its men had joined the 3rd Brigade. The 11th Company of the 4th Regiment is in the farmhouses at the northern entrance of Alt-Rognitz, and has pushed forward two sections both on the road on the western edge of the village; the 10th Company is on the isolated hill 423, and the rest of the Battalion is in rear of the 10th Company.

In this volume the battle is carried out to a successful termination.

Space does not allow us to give extracts from this work. Suffice it to say that no one, be he general, staff, regimental, or non-combatant officer; be he mounted soldier, infantry soldier, gunner or sapper, can fail to find in it lessons of the highest practical value. The volumes can be studied independently of each other, bearing in mind the "ordre de bataille" given above. Both volumes are equally worthy of perusal, but it is from the second that the regimental officer will learn most. In recommending them thus strongly to the military members of the Institution, we desire to say that we are fully alive to our responsibilities as critics of literature offered for officers' libraries, and that no books will be recommended for purchase save those which appear to be of real value to members of the profession.

The Elements of Field Artillery; designed for the Use of Infantry and Cavalry Officers. By HENRY KNOLLYS, Captain Royal Artillery. W. Blackwood, London. Price 7s. 6d. Size, $7\frac{1}{2}'' \times 5\frac{1}{2}'' \times \frac{3}{4}''$. Weight, 15 oz.

CAPTAIN KNOLLYS has met a real want by the publication of this small volume. In the preface to the work he says truly that, "For amateur artillerists" (meaning thereby officers of cavalry and infantry), "who enter on this subject as a collateral, not a main, object of their profession, the standard books supply information in excess of what is required. They are a little too lengthy, and a great deal too abstruse. The student is at a loss to sift what will be of practical use to him from what is intended for highly trained artillery officers, and to draw the line between the departments of field and garrison artillery. He is puzzled with technical expressions, and dismayed at the introduction of highly interesting but intricate calculations; and in nine cases out of ten he gives up the task in despair, believing that it can be grappled with successfully by members of 'the scientific corps' only."

It is with a view of obviating these difficulties that Captain Knollys has compiled this work. The contents are divided into three parts: the first treats of guns, ammunition, and carriages; the second, of the different descriptions of field artillery, drill, and administration; the third, of the practical employment of field artillery.

Captain Knollys is by no means wedded to old traditions, as the following sentence shows:—"There is, in fine, little doubt that if the opinions of field battery officers of our Royal Artillery were polled, the majority would express a preference for the breechloader. This opinion is backed up by the armies of nearly all civilized nations." Readers will find in the book the most modern notions with regard to artillery, expressed in clear language, devoid of all but the most necessary technicalities. There are, however, two points which non-artillerists reading this work will do well to bear in mind. At pp. 108-110, we find depreciatory criticisms on the mitrailleurs; and the author, like all artillery officers, seems unable to see that these weapons have their valuable qualities as well as their defects. The other point is, that much stress must not be laid upon the "Examples from Modern Warfare" which Captain Knollys has brought forward. Under this heading, we find accounts of the action of artillery at Friedland, 1807, where guns opened fire at 470 yards;

at Wagram, 1809; Fuentes d'Onor, 1811; and others. From the antiquarian point of view, these records are pleasant to peruse; but as examples of modern warfare, they are out of place in this excellent little work, intended, as it is, for practical use.

We can, however, confidently recommend the book to the members of the Institution; and we know no other work which so clearly and so concisely puts within reach of the Service generally that knowledge of the elements of field artillery which every officer ought to possess.

Historical Records of the Second Royal Surrey, or Eleventh Regiment of Militia, with Introductory Chapters. Compiled by JOHN DAVIS, Esq., Captain in the Regiment. Marcus Ward, London.

THIS volume commences with the early history of the Militia, and with the military events and levies in Surrey, from the days of Cæsar down to 1757. It was in 1759 that the 2nd Surrey were embodied, and the services of the regiment from that date, have found an industrious and enthusiastic historian in Captain Davis. Captain Davis in the south, and Captain Raikes in the north, are doing no small service in popularizing the idea of "Localization."

Règlement du 12 Juin, 1875, sur les Manœuvres de l'Infanterie. Titre I et II. Dumaine, Paris, or Dulau, Soho Square, London. Price 7½d. Size, 5½" x 3½" x ¾". Weight, 5 oz. Titre III. Price 6d. Size, 5½" x 3½" x ¾". Weight, 3 oz.

Instruction Pratique sur le Service de l'Infanterie en Campagne. Dumaine & Dulau. Price 1s. 6d. Size, 5½" x 3½" x ¾". Weight, 6 oz.

Instruction Pratique de la Compagnie d'Infanterie sur le Service en Campagne, &c. Par un Officier Supérieur du 4^o Corps. Dumaine & Dulau, 1877. Price, 5s. Size, 7½" x 4½" x 1¼". Weight, 1½ lbs.

THE first three of the above-named books were recommended to Students of Tactics by Lt.-Col. C. B. Brackenbury, in his Lecture on this subject, given at the Institution in February last.¹ The fourth book on the list is intended by its author to supplement the others, and to guide officers in conveying the instruction laid down in them, a purpose which seems satisfactorily carried out. As regards the other books recommended on the same occasion, it is desirable to say, in answer to inquiries on the subject, that it is hoped that the translation of the first volume of Helvig's "Tactische Beispiele," by Colonel Sir Lumley Graham, will appear in the course of a month. This work was fully reviewed in No. 86 of the Journal. The "Tactical Studies," by Major Hale, is one of the War Office Publications. Price 4s. 6d. Size, 9½" x 6" x 1½". Weight, 1 lb. 6 oz.

¹ Vol. xxi of the Journal, No. 89, p. 168.

